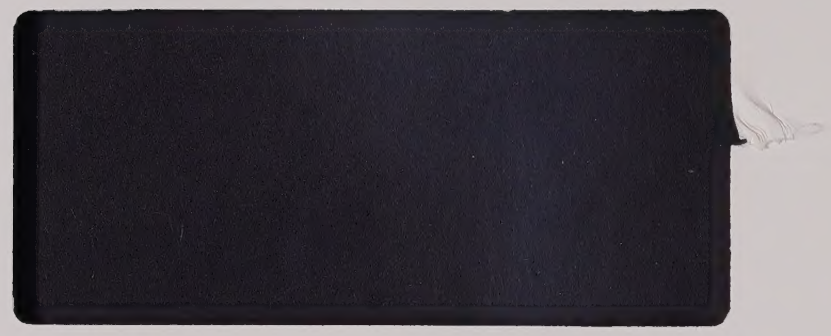
OPERATING & SERVICE MANUAL
FOR
RF UNIT

Models 431A, 432A, 433A, 434A, 435A, 438A and 442A

WEINSCHEL ENGINEERING

GAITHERSBURG, MARYLAND



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1974

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Table 1-1. Specifications

MODEL NO.	431A-1	432A	433A	434A	435A	438A-1	442A
FREQUENCY							
Range:	1.0-2.0 GHz	2.0-4.0 GHz	4.0-8.0 GHz	8.0-12.4 GHz	12.4-18.0 GHz	0.01-2.0 GHz	1.7-4.2 GHz
Accuracy (at 25°C)[1] (all modes):	±0.5%	±0.5%	±0.5% ±1% for 433A-H	±0.5%	±0.5%	0.01-1 GHz: ±10 MHz 1-2 GHz: ±0.5% 0.01-2 GHz: ±10 MHz ±1%	±0.5%
Linearity[2] (as % of Sweep Width):	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%
Peak Residual FM:	< 5 kHz	< 7 kHz	< 10 kHz	< 12 kHz	< 25 kHz	< 5 kHz	< 7 kHz
Stability:							
With Temperature:	< 200 kHz/°C	< 400 kHz/°C	< 500 kHz/°C < 3 MHz/°C with Option H	< 1.4 MHz/°C	< 3 MHz/°C	< 200 kHz/°C	< 400 kHz/°C
With 10% Change in Line Voltage:	< 10 kHz	< 20 kHz	< 30 kHz	< 40 kHz	< 60 kHz	< 10 kHz	< 20 kHz
With Full Range (40 dB) Change in Power Level:	< 1 MHz	< 1 MHz	< 1 MHz < 5 MHz with Option H	< 1 MHz	< 2 MHz	< 1 MHz	< 1 MHz
With 3:1 Load VSWR (All Phases):	< ±0.1%	< ±0.1%	< ±0.1% < ±0.5% with Option H	< ±0.05%	< ±0.05%	< ±0.1%	< ±0.1%
RF OUTPUT SIGNAL							
Minimum Leveled Power (at 25°C) Standard:	15mW[3]	15mW[3]	5mW[3]	6mW[3]	4mW[3]	15mW[3]	15mW[3]
High Power (Option H):	–	–	10mW[3]	10mW[3]	10mW[3]	–	–
Leveled Power Control Range:	> 15 dB	> 15 dB	> 15 dB	> 15 dB	> 15 dB	> 15 dB	> 15 dB
Power Variation Internal Leveling:	±0.5 dB	±0.5 dB	±0.5 dB	±0.7 dB	±1 dB	±0.5 dB	±0.5 dB
External Leveling[4]:	±0.1 dB	±0.1 dB	±0.1 dB	±0.1 dB	±0.1 dB	±0.1 dB[10]	±0.1 dB
Spurious Signal Rejection:							
Harmonics:	> 20 dB	> 20 dB	> 18 dB > 20 dB with Option H	> 30 dB	> 30 dB	0.01-1 GHz: > 20 dB[5] 1-2 GHz: > 20 dB	> 20 dB
Non-Harmonics:	> 60 dB	> 60 dB	> 60 dB	> 60 dB	> 60 dB	0.01-1 GHz: > 40 dB[6] 1-2 GHz: > 60 dB	> 60 dB
Residual AM:	> 50 dB	> 50 dB	> 50 dB	> 50 dB	> 50 dB	> 50 dB	> 50 dB
Output Connector Type:	N female	N female	N female	N female	WPM[7] female	N female	N female
MODULATION							
AM Input:							
Leveled Mode (Linear):							
Rise and Fall Time:	< 2.3 μsec	< 2.3 μsec	< 2.3 μsec	< 2.3 μsec	< 2.3 μsec	< 2.3 μsec	< 2.3 μsec
Frequency Response:	> 150 kHz	> 150 kHz	> 150 kHz	> 150 kHz	> 150 kHz	> 150 kHz	> 150 kHz
Modulation Sensitivity[8]:	≈ 2 dB/volt	≈ 2 dB/volt	≈ 2 dB/volt	≈ 2 dB/volt	≈ 2 dB/volt	≈ 2 dB/volt	≈ 2 dB/volt
On/Off Ratio:	> 40 dB	> 40 dB	> 40 dB	> 40 dB	> 40 dB	> 40 dB	> 40 dB
FM Input or Phase Lock:							
±2 dB Frequency Response:							
For ±20 MHz Deviation:	DC-100 kHz	DC-100 kHz	DC-100 kHz	DC-100 kHz	DC-100 kHz	DC-100 kHz	DC-100 kHz
For 100% of Band:	DC-1 kHz	DC-1 kHz	DC-1 kHz	DC-1 kHz	DC-1 kHz	DC-1 kHz	DC-1 kHz
Modulation Sensitivity (Nominal):	10 MHz/volt	20 MHz/volt	40 MHz/volt	44 MHz/volt	56 MHz/volt	10 MHz/volt	20 MHz/volt
Pulse Input[9]:							
Rise/Fall Time:	< 50 nsec	< 50 nsec	< 50 nsec	< 50 nsec	< 50 nsec	Not Applicable	< 50 nsec
WEIGHT	7 lbs.	7 lbs.	7 lbs.	7 lbs.	7 lbs.	7 lbs.	7 lbs.

NOTES

1. After 10 minutes warmup.
2. For Sweep Widths > 1% of Band.
3. Higher Power Units Available: Contact Factory.
4. Excluding External Directional Detector Variations.
5. At output power levels < 15 mW.
6. > 25 dB from 10 MHz to 150 MHz.
7. Mates with SMA.
8. Positive going Signal increases RF Output Power.
9. RF Unit must have 03 Option.
10. Single Band Mode Only.

Specifications subject to change without notice.

SECTION 1
GENERAL INFORMATION

1.1 SCOPE OF MANUAL

This manual contains information necessary for understanding the application and operation of the RF Unit used with the Model 430A Sweep Oscillator. The manual provides a general description, installation information, operating instructions, principles of operation and maintenance information. A complete set of schematic diagrams is also provided to aid in understanding the various modes of operation and proper servicing of the equipment.

1.2 DESCRIPTION

The RF Units are designed to be used in conjunction with the Weinschel Engineering Model 430A Microwave Sweep Oscillator to provide a sweepable range of 0.01 to 18.0 GHz. A typical RF unit is illustrated in Figure 1-1. An RF Unit installed in a 430A Sweep Oscillator is shown in Figure 1-2. The plug-in RF Unit is an integral part of the sweep oscillator circuitry and must be installed in the front panel compartment of the Model 430A to operate. Available RF Units covering seven frequency ranges are listed in Table 1-1. All standard RF Units are designed for external leveling. Optional RF Units with either internal or no leveling are also available.

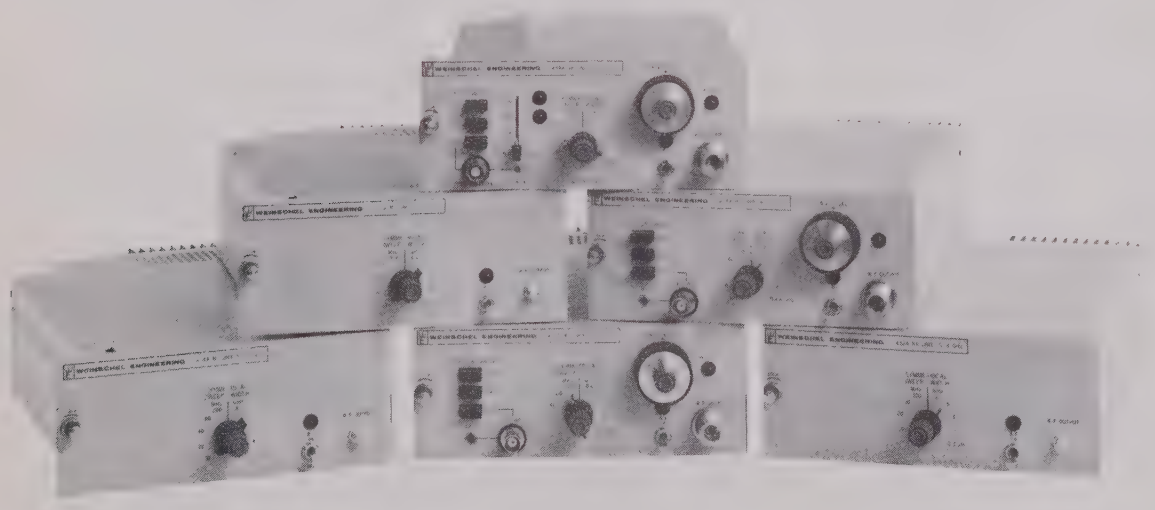


Figure 1-1. Weinschel Engineering's Series 430 Plug-In RF Units

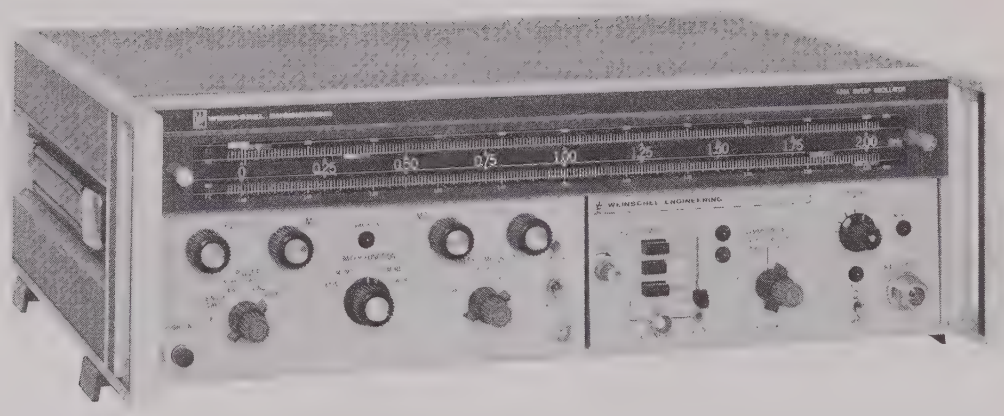


Figure 1-2. Weinschel Engineering Model 430A Sweep Oscillator with a Model 433A RF Unit Installed

A single band sweep oscillator is achieved by using the 430A and one plug-in RF Unit. To provide multiband operation with a continuous sweep output, the following additional accessory units are required.

	Two or more RF Units
Manually Controlled and not Multiplexed	Model 4301A RF Unit Holder (for operation over five or more octave bands). Each Model 4301A will hold only two RF Units. Model 4302A RF Unit Controller (used in conjunction with Model 4301A) will control up to and including six RF units.
Electronically Controlled and Multiplexed	Model 4309A Interface Unit or 435A/4309A for systems extending to 18 GHz. Model 4310A/K Control Unit

Each RF Unit is furnished with its own frequency scale. These scales are attached to the 430A Mainframe and are keyed to each Model RF Unit to ensure accurate frequency positioning.

SECTION 2
INSTALLATION

2.1 UNPACKING

The Weinschel Engineering Plug-In RF Units are shipped with the applicable frequency scale in a double carton with two inches of packing material between the inner and outer cartons. Use normal care when unpacking the instrument and removing the packing material. Do not destroy the cartons or packing material until the equipment is thoroughly inspected. If damage is found, notify the carrier immediately and do not destroy any packing material until an agent of the carrier has examined it. Under U.S. shipping regulations, damage claims must be collected by the consignee; do not return the instrument to Weinschel Engineering until a claim for damages has been established.

2.2 INSTALLATION OF RF UNIT IN 430A MAINFRAME

If another RF Unit is to be removed from the mainframe first, proceed as follows:

1. Turn off power (via the PUSH ON switch).
2. Unfasten and remove the frequency scale from the mainframe by loosening the two knurled screws.
3. Rotate the knurled LOCK knob on the RF Unit front panel counter-clockwise. Draw the RF Unit out of the mainframe by pulling on the LOCK thumbscrew.

Then, install the new RF Unit as follows:

1. Place the new frequency scale (furnished with the RF Unit) on the mainframe and fasten it by its two thumbscrews.
2. Rotate the knurled LOCK knob on the RF Unit front panel counter-clockwise. Insert the RF Unit into its compartment within the mainframe until its front panel is flush with the mainframe panel.
3. Rotate the knurled knob fully clockwise.
4. Power may now be turned on. The equipment is ready for operation immediately.

2.3 OPERATING TEMPERATURE RANGE

The RF Unit together with the Model 430A Mainframe is designed to operate within its specifications when the ambient temperature is between $-10^{o}C$ and $+50^{o}C$. Operating in ambient temperatures beyond these limits could affect the accuracy of the instrument and cause damage to its circuits.

2.4 REPACKING FOR SHIPMENT

To protect the unit during re-shipment always use the best packing methods available. When possible, use the original packing containers and cushioning material. If installed in the Model 430A during shipment make certain the plug-in RF Unit is securely locked in position and held there by cushioning material. If the original packing materials are not available, use the following procedure:

1. Wrap instrument in sturdy paper or plastic.

2. Place wrapped instrument in a strong shipping container; use a 3/4-inch layer of shock absorbing material around all sides of the unit to provide a firm cushion and prevent movement inside the container.

3. Thoroughly seal shipping container and mark it "FRAGILE".

4. If shipping for service, attach a tag to indicate.

    a) Service required.

    b) Description of malfunction.

    c) Model and Serial Numbers.

    d) Return Address.

    e) Authorization to conduct repairs.

SECTION 3
OPERATING INSTRUCTIONS

3.1 INTRODUCTION

This section provides a detailed description of the Model 430A Sweep Oscillator's operating controls, indicators and connectors, and contains the procedures for operating the instrument. This section also describes the controls and indicators located on the RF Unit.

The Model 430A, a versatile RF Signal Source of both swept and static frequencies provides four sweep modes: automatic, single, manual and external. The Mainframe and seven basic RF Units (See Table 1-2) provide a continuous range of coverage from 0.01 to 18.0 GHz.

3.2 FRONT AND REAR PANEL FAMILIARIZATION

3.2.1 Front Panel

Figure 3-1 illustrates and explains the function of all front panel fixtures for both the Mainframe (encircled numbers) and an RF Unit (encircled letters). Additional information regarding the proper use of the controls is provided in paragraphs 3.3 through 3.15.

3.2.2 Rear Panel

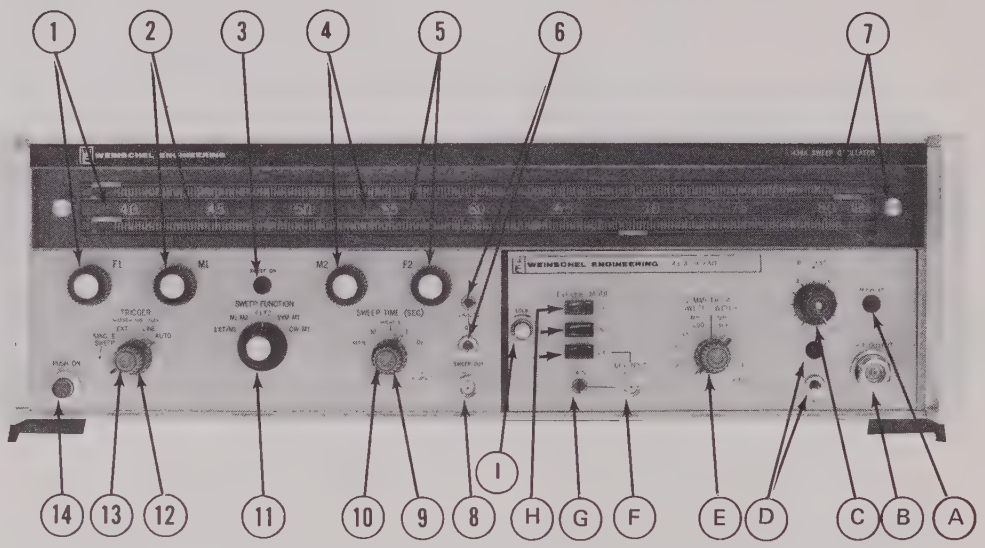
The identification and function of connectors and controls located on the rear panel for both the Mainframe (encircled numbers) and an RF Unit (encircled letters) are shown in Figure 3-2.

3.3 OPERATING CONSIDERATIONS

Information regarding operating features of the Model 430A along with controls on the RF Plug-in Unit is provided in the following paragraphs. A complete understanding of these considerations and their effects is recommended before using the instrument as a signal source.

3.4 APPLYING POWER

Momentarily depressing the PUSH ON pushbutton causes the pushbutton to light indicating that the Model 430A is ready to operate providing a RF Unit is installed. There is no waiting period for operation. (Depressing the pushbutton a second time will turn off the instrument.)



(1) **F1 Control and Marker:** Determines starting frequency for F1-F2 setting of SWEEP FUNCTION control and marker frequency in remaining settings except for CW M1.

(2) **M1 Control and Marker:** Determines (a) marker frequency for F1-F2, (b) sweep starting frequency for M1-M2, (c) center frequency for SYM M1, and (d) sweep starting frequency for EXT/M1 positions of SWEEP FUNCTION control.

(3) **SWEEP ON:** Indicator lights during forward trace of internally generated sweep, but is inoperative in manual sweep mode.

(4) **M2 Control and Marker:** Determines (a) second marker frequency for F1-F2, (b) the only marker frequency for EXT/M1, and (c) sweep limit frequency for M1-M2 positions of SWEEP FUNCTION.

(5) **F2 Control and Marker:** Determines (a) sweep limit frequency for F1-F2, and (b) marker frequency for both M1-M2 and SYM M1 settings of SWEEP FUNCTION.

(6) **1KHz ⊓⊔ ON Switch and Adjustment:** Controls voltage to square wave generator; adjustment varies frequency of square wave.

Figure 3-1. Front Panel Description

(7) **Frequency Scale and Retaining Screws:** Fourteen-inch scale (one per RF Unit)

(8) **SWEEP OUT:** Connector provides a Linear dc ramp voltage for driving the horizontal axis of oscilloscopes and chart recorders.

(9) **SWEEP TIME (SEC):** Selects one of four sweep times; also selects manual mode.

(10) **SWEEP TIME (SEC) VARIABLE:** Vernier provides adjustment of selected sweep time; Fully CCW setting increases sweep time by a factor of 10. In the Manual mode, the vernier is used to manually vary the sweep.

(11) **SWEEP FUNCTION:** Selects an internal mode, CW or external frequency (voltage) command.

(12) **TRIGGER:** Selects either AUTO, LINE or EXT mode for generating the sweep.

(13) **MARKER AMPLITUDE:** Provides continuous amplitude adjustment for video and RF markers.

(14) **PUSH ON:** Controls ac line power; depress once for ON and a second time for OFF.

(A) **UNLEVELED:** Indicator lights when RF output is not leveled across the entire frequency range.

(B) **RF OUTPUT:** Connector provides RF OUTPUT signal.

(C) **RF LEVEL Controls:** Knob sets amplitude of RF OUTPUT: screwdriver adjustment standarizes control action for various external detectors.

(D) **RF ON-OFF Switch and Indicator:** Controls V_{cc} to RF Unit; indicator lights when RF Unit is operating.

(E) **SYMMETRICAL SWEEP WIDTH Controls:** Select one of nine calibrated sweep widths; vernier provides adjustment of the selected width.

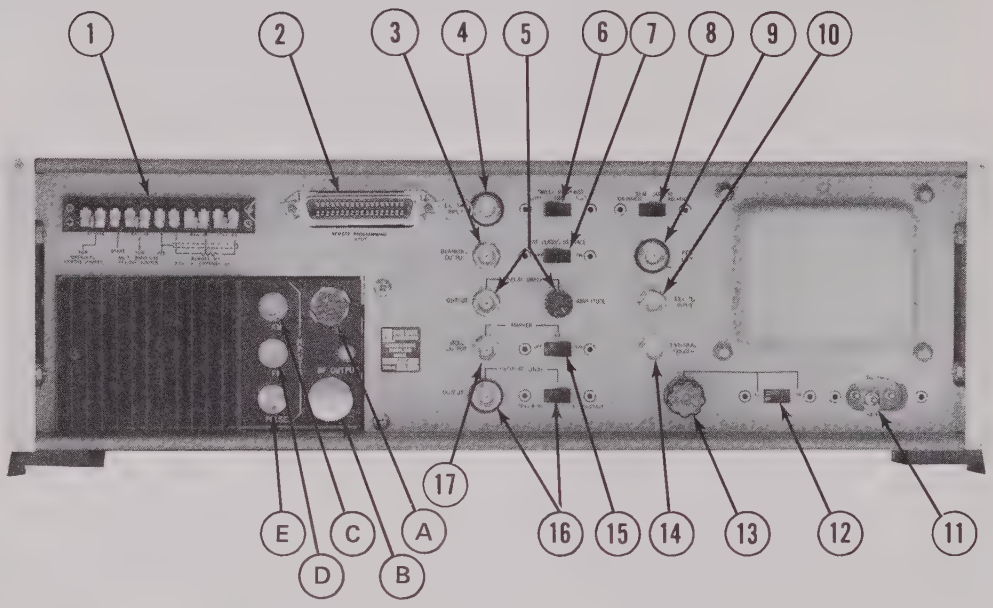
(F) **EXT DET INPUT:** Input connector for external leveling signal.

(G) **GAIN:** Adjustment controls Leveler gain in the Power Meter mode.

(H) **LEVELER MODE Controls:** Selects one of three basic modes of operation: OFF, INTernal or EXTernal. (Internal leveling available only with −1 option.

(I) **LOCK:** Captive screw secures RF Unit in Mainframe.

Figure 3-1. Front Panel Description (Cont.)



(1) **TB1:** Terminals 1,2,3 (auxiliary); 4 and 5 (normally shorted); 6 thru 11 (remote frequency control)

(2) **REMOTE PROGRAM INPUT:** Input connector for remote digital BCD control of output frequency and remote RF ON/OFF Control.

(3) **BLANKING OUTPUT:** Connector provides a negative pulse during retrace and prior to initiation on next trace.

(4) **EXT SWEEP INPUT:** Input connector for 0 to +10 volt input sweep command.

(5) **DISPLAY SWEEP OUTPUT and AMPLITUDE:** Output is identical to front panel SWEEP OUT; control adjusts amplitude of both front and rear panel SWEEP OUTPUT signals.

(6) **SWEEP RESPONSE TIME:** Switch controls bandwidth of tunning supply. In AUTO the bandwidth is automatically adjusted according to rate of change of the input voltage; in FAST the bandwidth always remains in its widest bandwidth.

Figure 3-2. Rear Panel Description

(7) **RF DURING TRACE:** Switch provides a choice of RF ON or OFF during retrace.

(8) **SYM MARKERS:** Switch Selects CALIBRATED MARKERS, read from the frequency scale, or RELATIVE markers of constant narrow width in SYM M1 mode.

(9) **PEN LIFT:** Terminal provides a relay closure signal during forward trace.

(10) **EXT SQUARE WAVE:** Input connector for external RF modulation square wave for RF Modulation; — 10 volts turns off RF power.

(11) **LINE INPUT:** 3 - wire male connector.

(12) **Line Voltage:** Switch Sets Model 430A for 115V or 230V operation.

(13) **Power Line Fuse:** 115V/3A or 230V/1.5A.

(14) **EXTERNAL TRIGGER:** Connector for —10 volt input trigger signals.

(15) **RF MARKER:** Switch Provides amplitude dips on the RF output.

(16) **PROPORTIONAL OUTPUT and Switch:** Connector provides a voltage proportional to the instantaneous RF output. Switch selects either 10V/BAND or 40V/OCTAVE scale factor for the proportional output voltage.

(17) **VIDEO MARKER OUTPUT:** Connector provides a negative signal when the RF and marker frequencies coincide. RF MARKER switch does not affect this output.

(A) **J1:** Input connector for a remote tuning input. (Remove External Jumper)

(B) **RF OUTPUT:** This connector only present on RF Units with "R" option.

(C) **AM INPUT:** Input connector for amplitude modulation signals.

(D) **FM INPUT:** Input connector for frequency modulation signals and phase locking signals.

(E) **PULSE INPUT:** Input connector for pulse signals which provide a rise and fall time < 50 ns. (Only available with the —03 option.)

Figure 3-2. Rear Panel Description (Cont.)

3.5 SWEEP MODES

3.5.1 Automatic

One of four automatic sweep times can be selected by setting the SWEEP TIME (SEC) control to either .01, .1, 1 or 10 and setting the SWEEP FUNCTION control to M1-M2, F1-F2 or SYM M1. The SWEEP TIME (SEC) settings are only accurate providing the VARIABLE control is set to CALIBRATED (fully clockwise). Rotating the VARIABLE control from fully clockwise to fully counterclockwise increases the sweep time from zero to ten times the interval indicated (.01, .1, 1, or 10) with a maximum sweep time of 100 seconds. The SWEEP ON indicator will light during a forward portion of the sweep.

3.6 SWEEP TRIGGER SELECTION

3.6.1 Automatic

With the TRIGGER selector set to AUTO, the sweep is automatically generated upon completion of a retrace, i.e. recurrent free-running operation. A short dwell time is provided at the start and finish of each trace for equilibration.

3.6.2 Line

In the LINE position, a sweep is triggered by the occurrence of the next line frequency cycle following completion of retrace.

3.6.3 External

Setting the TRIGGER selector to EXT allows a −10 volt signal, applied to the EXTERNAL TRIGGER connector on the rear panel, to trigger a new sweep upon a receipt of the next negative going external trigger signal following completion of retrace.

3.6.4 Single Sweep

Rotating the TRIGGER selector fully counterclockwise generates a single sweep. The control is spring loaded and will not remain in the SINGLE SWEEP position. A second manual sweep can be initiated by rotating the selector fully counterclockwise again following completion of retrace.

3.7 SWEEP FUNCTION MODES

3.7.1 F1 - F2 Modes

With the SWEEP FUNCTION selector set to F1 - F2, the output frequency sweeps between the limits set by the F1 and F2 controls. Normally the low frequency limit is set by

F1 and the high limit by F2, resulting in a sweep that goes from a low to a higher frequency. However, F1 can be used to set the high limit and the F2 marker used for the low limit, thereby establishing a high to low frequency sweep. The electronic Yig lag compensation will not be operative when sweeping from a high to a low frequency.

Two calibrated markers are controlled by the M1 and M2 controls when in the F1-F2 sweep mode, each continuously adjustable over the entire frequency range.

3.7.2 M1 - M2 Mode (Expanded Sweep)

The M1 - M2 markers provide the means of selecting any portion of the F1 - F2 frequency range for expanded display. With the SWEEP FUNCTION selector set to F1 - F2 mode, adjust the M1 and M2 controls to position the M1 and M2 markers at either side of the range to be expanded. Then, when the sweep function selector is switched to the M1 - M2 mode, the frequency range established by the two markers is now the full width of the swept frequency display.

3.7.3 SYM - M1 Mode (Symmetrical Sweep)

Setting the SWEEP FUNCTION selector to SYM M1 and adjusting the M1 control to position the M1 marker to the desired center frequency will cause the trace to sweep symmetrically about the center frequency established by M1. The total sweep width (peak-to-peak excursion) is determined by the setting of the SYMMETRICAL SWEEP WIDTH control located on the front panel of the RF Unit.

When the SYM MARKERS switch located on the rear panel is set to CALIBRATED, F1 and F2 markers are directly calibrated by the frequency scale and cover the entire frequency range of the RF Unit. Positioning the SYM MARKERS switch to RELATIVE causes the markers to become quite narrow ranging only over the symmetrical sweep frequency width in use.

The symmetrical mode is convenient for making narrowband measurements since the frequency excursion is calibrated to within $\pm 3\%$ (for Yig tuned RF Units and $\pm 10\%$ for Varactor tuned RF Units) of the SYMMETRICAL SWEEP WIDTH range selected. For narrow sweep width this is substantially more accurate than the markers. The SYMMETRICAL SWEEP WIDTH selector provides nine convenient steps from approximately 0.2% to 100% of the sweep range for the RF Unit. Rotating the selector fully clockwise activates the concentric control which is used to continuously vary the sweep width over the full frequency range.

The symmetrical mode may also be used as an expansion of the F1 - F2 mode, when the M1 marker is set to the center of that portion of the F1 - F2 display to be expanded.

The center frequency may also be remotely programmed via the terminal strip (① , in Figure 3-2) located on the rear panel. When jumpers linking terminals 8 to 9 and 10 to 11 are removed, remote voltage from 0 to -10 volts (applied to terminal 9 with respect to terminal 7) will linearly control the center frequency over the full range. A potentiometer (1K recommended) or a resistor divider placed at terminals 7, 9 and 11 will also determine the center frequency over its full range.

If several center frequencies are required, an external switch or pushbutton control can be used to select from a number of remote programming voltages, potentiometers or resistor divider networks.

3.7.4 CW M1 Mode

When the SWEEP FUNCTION selector is set to the CW M1 position the automatic sweep mode is disabled and the output frequency is determined by the setting of the M1 control. The SWEEP ON indicator does not function in this mode.

With the SWEEP FUNCTION selector set to F1 - F2, the M1 marker may be preset to a frequency of interest. When the SWEEP FUNCTION selector is placed in the CW M1 position the sweep will automatically stop at the frequency identified by the position of the M1 marker.

Remote frequency programming may be accomplished via the rear terminal strip as described in paragraph 3.15.

3.7.5 EXT/M1 Mode

When the SWEEP FUNCTION selector is set to the EXT/M1 position the automatic sweep is disabled and the output frequency is determined by an external voltage applied to the EXT SWEEP INPUT connector (located on the rear panel) and the setting of the M1 control. An analog voltage from 0 to +10 volts will control the frequency over the entire range of the RF Unit. The SWEEP ON indicator does not function in this mode.

One calibrated marker, M2 set by the M1 control and is continuously adjustable over the entire range.

3.8 SWEEP RESPONSE TIME CONTROL

With the SWEEP RESPONSE switch (located on the rear panel) set to AUTO, the response (bandwidth) of the tuning supply is automatically adjusted according to the rate of change of the input tuning voltage — whether internally or externally generated. In this manner, a minimum noise bandwidth is maintained to ensure the lowest possible residual FM regardless of sweep rate. Setting the SWEEP RESPONSE to FAST forces the bandwidth to remain at its widest at all times.

3.9 RF LEVEL

The continuously variable RF LEVEL control (front panel) is used to vary the amplitude of the RF output. Maximum RF output level is obtained by rotating the RF LEVEL fully clockwise. The screwdriver adjustment located in the center of the RF LEVEL control may be used as a coarse RF LEVEL control. The LEVELER MODE OFF pushbutton should be depressed unless leveled power is to be used.

3.10 RF POWER LEVELING

3.10.1 General Considerations

The Model 430A with any RF Unit installed is capable of maintaining a constant amplitude RF output across the frequency range. This is accomplished by comparing the dc level from an RF amplitude sampling device with the amplitude command of the RF LEVEL control. The difference (or error) is amplified and applied to a voltage attenuator which reduces the amplitude of the RF output to the desired level.

The RF LEVEL control sets the maximum amplitude of RF power across the frequency range. Consequently, the RF output will be leveled in those portions of the frequency band where there is sufficient RF power but will remain unleveled in any portion where the amplitude of the RF power falls below the level established by the RF LEVEL control. The UNLEVELED indicator will only be illuminated during those portions of the sweep that are not leveled.

The RF LEVEL control may be adjusted to obtain a leveled output across the entire frequency range, or if required, may be set to obtain a leveled output only over that portion of the range where the amplitude of the RF power is higher. Since minimum power output usually occurs at one end of the frequency range, the RF LEVEL control should be adjusted for leveled operation at that end of the range to obtain leveled operation across the entire frequency range.

3.10.2 Internal Leveling

No external equipment is required to provide leveled RF power when using an RF Unit featuring internal leveling circuitry. These units have an internal directional detector consisting of a flat broadband directional coupler with a crystal detector. To activate the internal leveling function, simply depress the front panel LEVELER MODE INT pushbutton and adjust the RF LEVEL control as discussed in paragraph 3.10.1.

3.10.3 External Crystal Leveling

The output from any RF Unit may be leveled (except for those units with the –2 option) by using a remote RF amplitude sampler. This is especially desirable at the higher microwave frequencies to assure flat power at the input to the divice under test. External leveling is also used to remove any power variations which may otherwise be introduced by a device inserted in the RF path such as a filter, an amplifier or a long transmission line.

For sweeping at high speeds to obtain a flicker-free oscilloscope display, depress the LEVELER MODE EXT pushbutton. In this mode the leveling system may be used with a directional coupler (typically 10 dB) and a flat broadband crystal detector. A directional detector consisting of a coupler/crystal detector combination in a single package may also be used.

For optimum results over a frequency range of less than 2:1, a low pass filter with cutoff frequency at the high end of the desired band may be inserted before the directional coupler. The influence which any small harmonic content of the RF signal might have on leveling is thus prevented.

3.10.4 Power Meter Leveling

The ultimate in leveling accuracy and flatness across a broad band is obtained by substituting a RF power meter for the crystal detector as discussed in paragraph 3.10.3. The long response time, however, of power meter thermistor mounts restricts Sweep Time selection to the two slower ranges, 1 SEC and 10 SEC, of the SWEEP TIME (SEC) control. These two ranges are also suitable for use in conjunction with an X-Y recorder or with oscilloscopes other than the long persistence display types.

The power meter should have a minimum output of 1 volt or 1 milliampere. Either polarity may be used. Typically, a 10 dB directional coupler and a low pass filter are used in the same manner described in Paragraph 3.10.3. A leveled output power indication is calculated by adding the directional coupler's coupling factor in dB to the power meter indication. The output power indication is influenced by both the front panel RF LEVEL control setting, and on the range selected for the power meter. It might be necessary to re-adjust the GAIN control when changing settings of the power meter range switch. The GAIN control on the front panel is only operative in the POWER METER MODE of leveling.

When square wave modulation is used the leveling action of the power meter maintains constant (average) power. Since the duty factor of the internal square wave is 50%, the peak RF power will be twice the value indicated by the average reading on the power meter.

To minimize transients at the start of the sweep, it is recommended that the RF DURING RETRACE switch (located on the rear panel) be placed to ON. Refer to paragraph 3.12 for more details.

3.11 FREQUENCY MARKERS

Two independent calibrated frequency markers are generated for each sweep mode except for the EXT/M1 mode. These markers are available as negative video signals at the VIDEO MARKER OUTPUT connector located on the rear panel. The marker waveforms may be displayed on the second channel of a dual trace oscilloscope, on an X-Y recorder, used as an oscilloscope intensity variation signal or used to activate systems such as a network analyzer.

Placing the RF MARKER switch (rear panel) to ON causes the RF markers to be displayed as a sharp dip in RF power. Marker amplitude is varied by the continuously adjustable MARKER AMPLITUDE control located on the front panel.

3.12 BLANKING DURING RETRACE

When the RF DURING RETRACE switch (rear panel) is set to OFF, the RF power is turned off during retrace of the internally generated sweep. This feature provides a zero power reference base line for the RF display. Dwell time is also provided at both start and finish of sweep. Setting the switch to ON provides RF power during both trace and retrace. This is useful for power meter leveling setups and for chart recorder operation since it eliminates large changes in amplitude at the beginning and end of sweep.

A negative video pulse coincident with the retrace is present at the BLANKING OUTPUT connector. In addition, a contact closure during forward trace is available at the PEN LIFT terminals for use with recorders having the capability to discontinue writing during retrace. The PEN LIFT terminals automatically remain open in MANUAL sweep mode, the .1 and .01 SEC SWEEP TIME settings and when primary power is OFF.

3.13 AMPLITUDE MODULATION

3.13.1 Internal Square Wave

The internal 1 kHz square wave generator, especially useful with a tuned detection amplifier, may be activated in any mode by setting the 1 kHz ⊓⊔ switch to ON. The associated front panel screwdriver adjustment provides the means to change the frequency over a range from 950 to 1050 Hz. The oscillator which provides 100% modulation has a peak power value identical with square wave off power in Leveling OFF or XTAL. In the power meter leveling mode, the average power remains the same and may require resetting the RF LEVEL control to maintain peak power within the RF Units maximum output capability.

3.13.2 External AM

An external amplitude modulating signal may be applied to the AM INPUT connector located on the rear panel of the RF Unit. External modulation signals are mixed directly with the output of the RF LEVEL control circuit. Amplitude distortion of the modulation is minimum when XTAL leveling is used. Power will remain linear with an external amplitude modulating signal when power meter leveling is employed, but frequency response is somewhat limited. Adjusting the RF LEVEL CONTROL will center the dynamic range of the amplitude modulating input signals.

3.13.3 External Pulse

Pulse modulation input signals may be applied to the AM INPUT on the rear panel of the RF Unit. When using the AM INPUT a positive going voltage increases the power levels above that value set by the RF LEVEL CONTROL (unless LEVEL CONTROL is fully counterclockwise) and a negative going signal decreases power below the value set by the level control. A rise and fall time of approximately 2 μsec is possible when using the AM INPUT connector.

If rise and fall times of <50 nsec are necessary, the −03 option is required and a DTL or TTL signal (0 volts to +5 volts) may be applied to the PULSE INPUT connector. The −03 option may be programmed, through a jumper on the −03 option board, to cause RF ON for +5 volts at the PULSE INPUT connector and RF OFF for 0 volts or for the inversion of this mode. If the RF Unit is not equipped with the −03 option, the PULSE INPUT connector is not operative.

3.14 DISPLAYING SWEPT FREQUENCY MEASUREMENTS

For rapid evaluation or adjustment of a device under test, the oscilloscope is generally the most convenient display method. A simple setup using a broadband crystal detector, a pad and an oscilloscope is illustrated in Figure 3-3.

The RF output after passing through the pad and the device under test is converted to a video signal by the crystal detector and applied to the vertical input of the oscilloscope. The pad is used to provide a proper source match and to reduce the power level so that the detector operates within its square law region. A sweep signal from either the front panel SWEEP OUTPUT connector or the rear panel DISPLAY SWEEP OUTPUT connector is used to provide the horizontal drive for the oscilloscope. The DISPLAY SWEEP AMPLITUDE control located on the rear panel of the Model 430A or the horizontal gain control on the oscilloscope may be used to adjust the display width.

Measurements will be enhanced by leveling, as discussed in paragraph 3.10.

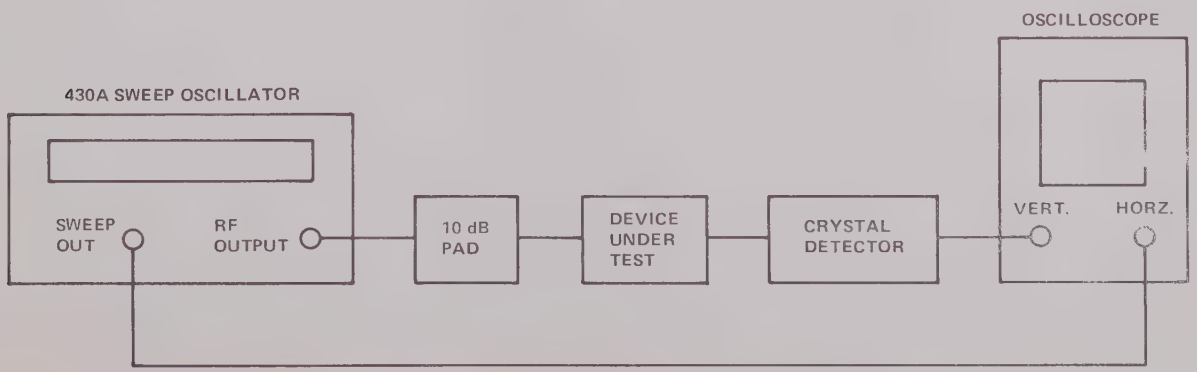


Figure 3-3. Swept Frequency Measurement Test Set-Up Using an Oscilloscope Display.

The X-Y recorder may also be used to obtain a permanent record of the evaluation or adjustment of the device under test. As shown in Figure 3-4, the test setup using the recorder is very similar to the one for the oscilloscope. The SWEEP TIME (SEC) control must be set to either 1 or 10 and the vernier adjusted to meet the response time of the recorder. If the recorder has a pen lift or equivalent writing enable-disable feature it should be connected to the rear panel PEN LIFT terminals on the Model 430A to prevent chart marking during retrace.

The recorder X and Y scale factors and zero suppression may be conveniently adjusted by setting the SWEEP TIME (SEC) selector to MAN and rotating the associated concentric VARIABLE control knob.

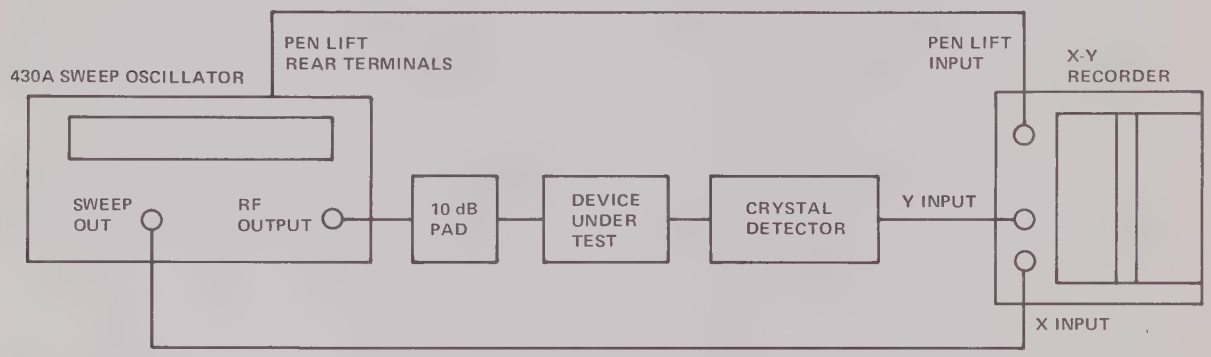


Figure 3-4. Swept Frequency Measurement Test Set-Up Using an X-Y Recorder Display.

3.15 REMOTE PROGRAMMING OF FREQUENCY AND AMPLITUDE

The Model 430A Sweep Oscillator may be remotely controlled by using an external negative or positive going analog voltage, a resistance source or BDC logic level to determine the output frequency and the power level. Wideband remote frequency control e.g. phase locks, must be applied via the RF Unit rear panel FM INPUT connector. Frequency deviation is superimposed on the output frequency, determined by the other inputs and controls.

3.15.1 Frequency — Analog Voltage Control

Remote control of the output frequency through the use of a 0 to +10 volt signal, that may be either dc or a special waveform, is accomplished by setting the SWEEP FUNCTION selector to EXT/M1 and applying the input control voltage to the rear panel EXT SWEEP INPUT connector. The F1 and F2 controls are inoperative but the M2 control still sets the M2 marker. In this mode the M1 control determines the 0 volt start frequency.

To effect frequency control by using a 0 to −10 volt signal requires setting the SWEEP FUNCTION selector to CW M1, or if the remote signal is being modulated then set the SWEEP FUNCTION SELECTOR to SYM M1. Remove the jumper from terminals 8 and 9 of TB-1 (located on the rear panel) and connect the input signal to terminal 9 and the signal return to terminal 7. (If a shielded cable is used, connect the shield to terminal 6.) The internal electronic sweep provides a calibrated symmetrical sweep, having its width set by the SYMMETRICAL SWEEP WIDTH control

located on the RF Unit, which sweeps about the center frequency as determined by the input control voltage. The M1 control is ineffective; F1 and F2 controls still provide normal control over the F1 and F2 markers. If desired, the internal electronic sweep may be disabled by setting the SWEEP TIME (SEC) selector to MAN, or by setting the TRIGGER selector to EXT and positioning the SYMMETRICAL SWEEP WIDTH control to 5 MHz.

Rear panel connector J1 may also be used as an input for a remote control voltage. This input may be used alone or in conjunction with any of the remote programming techniques being discussed.

A voltage applied to pins A and B (signal to B and return to A) of connector J1 operationally adds to the output frequency in every mode. This feature may be especially convenient when used as a vernier control about a preset frequency. A 10 volt change covers the entire frequency band of the RF Unit with an increase in frequency corresponding to a more positive voltage level.

3.15.2 Frequency — Resistance Control

Controlling the output frequency through an external resistance source is accomplished by connecting a resistance divider or a potentiometer (1 K recommended) to terminal strip TB1 located on the rear panel. Connect the external resistance to terminals 7, 9 and 11 as illustrated just below the terminal strip. Place the SWEEP FUNCTION selector to CW M1, or if the remote signal is being modulated then set the SWEEP FUNCTION selector to SYM M1. The internal sweep provides a calibrated symmetrical sweep, having a width set by the SYMMETRICAL SWEEP WIDTH CONTROL located on the RF Unit, that sweep about the center frequency determined by the input control signal. The M1 control is ineffective; F1 and F2 controls still provide normal control over the F1 and F2 markers. The automatic sweep may be disabled by setting the SWEEP TIME (SEC) to MAN or by setting the TRIGGER selector to EXT. Since the remote resistance divider replaces the function of the M1 control, this type of setup permits remote marker control in the F1 - F2 mode, and remote sweep start control in the M1 - M2 mode.

3.15.3 Frequency — Digital Control

To implement remote control via externally generated digital signals requires that the —01 option, which is a plug-in PC card, be installed in the Mainframe (see 430A Mainframe Manual). The REMOTE PROGRAM INPUT connector, a 36-pin rear panel mainframe connector, provides twelve digital input lines for a remotely generated 3-digit BDC word used to determine the frequency. One input line, Remote Enable, is provided to control the mode of operation — either local or remote. A second input line is provided for strobing the 12-line, 3-digit BDC input lines. If the strobe line remains open (a logic "1" condition) any 12-bit work present at the input lines will determine the output frequency. Placing a ground (a logic "0" condition) on the strobe line causes the unit to hold the last 12-bit word, regardless of the state of the 12-input lines, until the strobe line changes to a logic "1" condition. This feature allows a given 12-bit word, corresponding to a specific frequency (F_1), to be held in memory as long as the strobe input line remains at a logic "0", even though the digital words on the 12-line may be changing.

One additional line is provided for remote control of the RF ON/OFF switch on the front panel of the RF Unit. Applying +5 volts to this line shuts off the RF source power; leaving the line open or at 0 volts turns on the RF source power so long as the RF ON/OFF toggle switch on the front panel is set to ON. This line is standard equipment on the Model 430A and is not part of the —01 option for the mainframe.

3.15.4 RF Amplitude — Voltage and Resistance Control

The amplitude of the RF output signal is easily controlled by simply applying a command input voltage to the AM INPUT connector located on the rear panel. An analog voltage of either 0 to +5 volts or 0 to −5 volts, will cause the amplitude to change across its entire range with a negative going voltage corresponding to a decrease in the output power level. The power level will vary around the setting of the RF LEVEL control according to the AM input signal.

3.16 FREQUENCY MODULATION

3.16.1 External FM

An external frequency modulating signal may be applied to the FM INPUT connector located on the rear panel of the RF Unit. Positive going voltages cause the frequency to increase with respect to the center frequency and negative going voltages cause the frequency to decrease with respect to the center frequency. For this mode of operation, the SWEEP FUNCTION SELECTOR switch on the front panel of the Mainframe should be set to the SYM M1 position, the SWEEP TIME switch set to MAN and the SWEEP RESPONSE TIME slide switch on the rear panel of the Mainframe should be set to FAST. Set the SYMMETRICAL SWEEP WIDTH switch on the plug-in unit to the fully counterclockwise position. The M1 control will be used to set the center frequency. The input impedance at this port is approximately 5K ohms to ground. The input/output relationship for YIG tuned RF Units is determined by the model number of the RF Unit:

431A	10 MHz/volt
432A	20 MHz/volt
433A	40 MHz/volt
434A	44 MHz/volt
435A	56 MHz/volt
438A	10 MHz/volt

3.16.2 Phase Locking

Phase locking is possible by applying the error signal from the "LOCK BOX" to the FM INPUT connector.

For this mode of operation, the SWEEP FUNCTION selector switch on the front panel of the Mainframe should be set to the SYM M1 position, the SWEEP TIME switch set to MAN and the SWEEP RESPONSE TIME slide switch on the rear panel of the Mainframe should be set to FAST. Set the SYMMETRICAL SWEEP WIDTH switch on the plug-in unit to the full counterclockwise position. The M1 control will be used to set the center frequency.

SECTION 4
PRINCIPLES OF OPERATION

4.1 INTRODUCTION

This section contains a block level description of the 430A sweep system along with a detailed description of individual circuits. Complete schematic diagrams are provided in Section 7.

4.2 BLOCK DIAGRAM DESCRIPTION OF STANDARD SYSTEM

The Model 430A Mainframe, as shown in Figure 4-1, contains sweep generating circuitry consisting of a sweep trigger, sawtooth oscillator, sweep limiter and sweep amplifiers; a frequency marker generator; a square wave generator (for internal amplitude modulation); and a power supply section for generating the various voltages required for both the mainframe and the RF Unit.

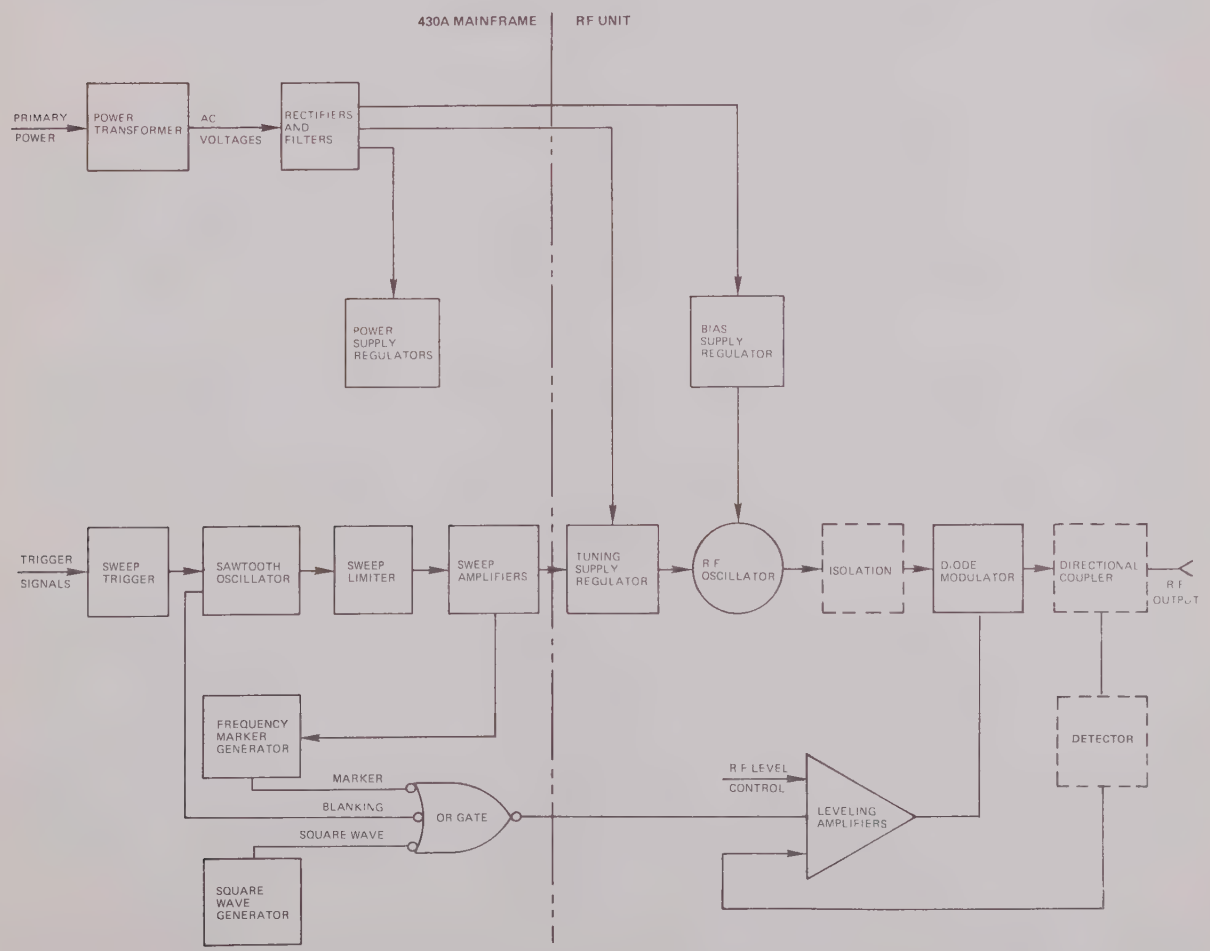


Figure 4-1. Block Diagram of Model 430A Mainframe and RF Unit

The function of the sweep trigger circuit is to reshape and standardize the negative going input trigger signal. The resultant positive output pulse is used to trigger the sawtooth generator which in turn develops a negative sawtooth voltage. This 0 to −12 volt waveform after being inverted and limited to +10 volts by the sweep limiter is applied to the sweep amplifiers which modify the positive point waveform in accordance with the front panel SWEEP FUNCTION control setting. The modified output from the sweep amplifiers is used to drive the tuning supply regulator which in turn controls the RF oscillator. As a result, the oscillator sweeps only that portion of its frequency range which corresponds to the sweep amplifiers' output waveform.

The amplitude of the RF output signal is determined by the electronically controlled attenuation of the diode modulator located in the RF Unit. The leveling amplifiers section drives the modulator with a control current determined by the setting of the RF LEVEL control. When leveling is in operation, a portion of the RF output is sampled by the directional coupler, detected and fed back to the leveling amplifiers as a negative feedback control signal. As the output frequency is varied the leveling control loop maintains the detector output at a constant level. The amplitude variation of the RF output therefore depends only on the characteristics of the directional coupler/detector combination.

The frequency marker generator circuit compares a sweep voltage with the marker control voltage to develop marker signals at the corresponding RF frequencies. The square wave generator, the retrace blanking signal and the markers, when individually activated by front or rear panel controls are gated through the OR gate and applied to the leveling amplifiers as modulation.

4.2.1 Block Diagram Description of 438A RF Unit Heterodyne System

The 438A RF Unit is a dual range plug-in covering 10 MHz - 1 GHz in one band and 1 GHz to 2 GHz in the second band. A 1 - 2.2 GHz oscillator is used to provide direct output of 1 - 2 GHz and is heterodyned with a 1.2 GHz oscillator to provide the 10 MHz to 1 GHz output. Switching from one band to the other is accomplished with all solid-state switching and it therefore can be switched back and forth in microsecond time intervals.

A system block diagram is shown in Figure 4-2. The switches are shown in the position corresponding to the 10 - 1000 MHz range. The output of the 1 - 2.2 GHz oscillator is the higher level signal and it mixes with the lower level fixed frequency oscillator at 1.2 GHz. The level of the mixer output is controlled by a diode modulator which, in turn, controls the level of the 1.2 GHz signal. A 1.2 GHz bandpass filter is required to reduce the second harmonic content and thereby reduce undesirable mixing products that appear as spurious signals in the output. A 1 GHz low pass filter rejects the direct mixer feed-through from each of the oscillators.

The signal is then amplified and fed to a directional detector. Here a sample of the RF is detected and connected to the input of the leveling amplifier to complete the leveling feedback loop. The leveled RF output is then connected to the front panel output via the 1 - 2 GHz directional coupler. This 1 - 2 GHz directional coupler has negligible effects on the 10 - 1000 MHz output.

When the control logic requires it, the solid state switches are switched and the range is changed to 1 - 2 GHz where the output of the tunable oscillator is connected to the 1 - 2 GHz directional coupler. The RF is sampled and detected and then coupled via the leveling amplifier to a solid state RF switch used as a RF diode modulator to complete the feedback leveling loop.

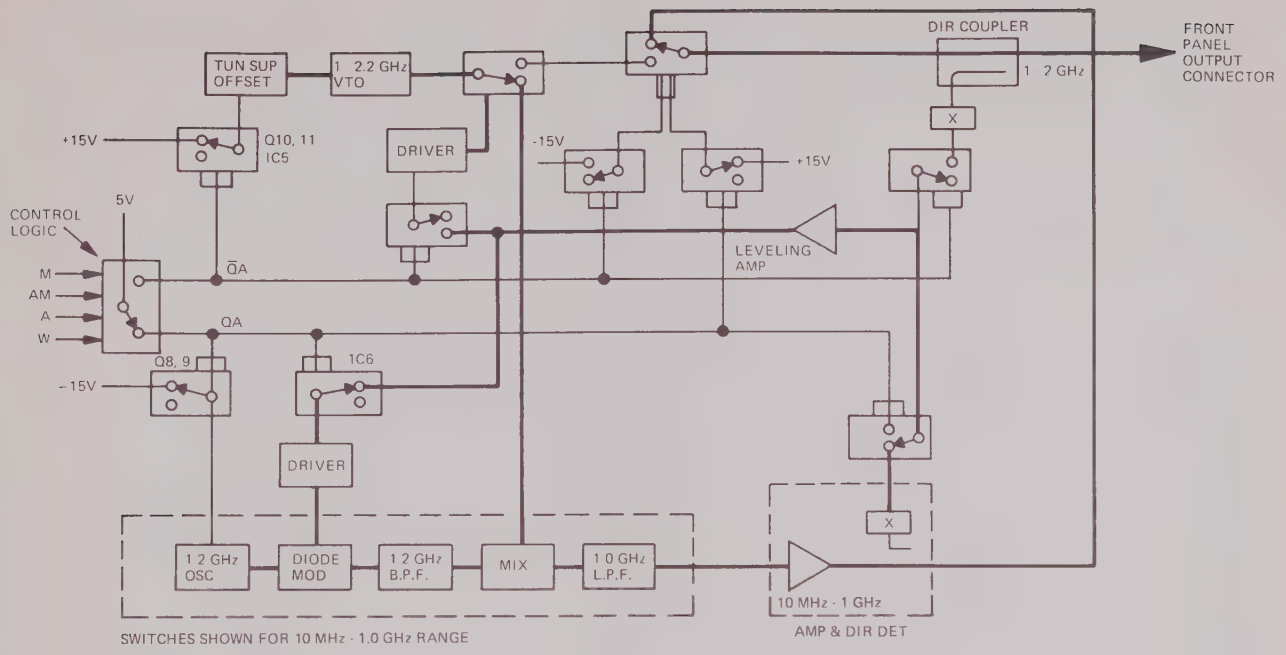


Figure 4-2. Block Diagram of 438A RF Unit Heterodyne System

4.3 CIRCUIT DESCRIPTIONS

The following sections describe the circuits and controls located on assemblies:

A1	Leveler
A2	Tuning & Bias Supply
A3	Auxiliary (Except 438A)
A3	Heater (438A only)
A4	Symmetrical Sweep Width
A5	Control Logic (438A only)
A11	Heat Exchanger ("X" and "Ku" Bands only)

4.3.1 Tuning Supply, YIG

The feedback amplifier used to control the current in the tuning coils of the YIG tuned oscillator is shown in Figure 4-3. The circuit is configured as a current regulator. The voltage across the R sense resistor is determined by the ratio of R105 to R29 and the amplitude of the input tuning voltage. The current that flows through the YIG tuning coil is then determined by V_o and the parallel combination of R sense and R105. R sense is made to be considerably smaller than R105 and it dominates in setting the value of tuning coil current. The tuning coil current therefore is directly proportional to the input tuning voltage.

Under certain circumstances, the effective value of the input tuning voltage can drive the YIG tuning coil current beyond its normal operating range, and cause the RF oscillator to switch to a different mode of oscillation. This would result in an erroneous RF output from the sweeper. To prevent this from happening, a high frequency clamp (Amp 3) circuit is used. The values of R83 and R86 are selected so that when V_o exceeds a specified level, a signal appears at the output of Amp 3.

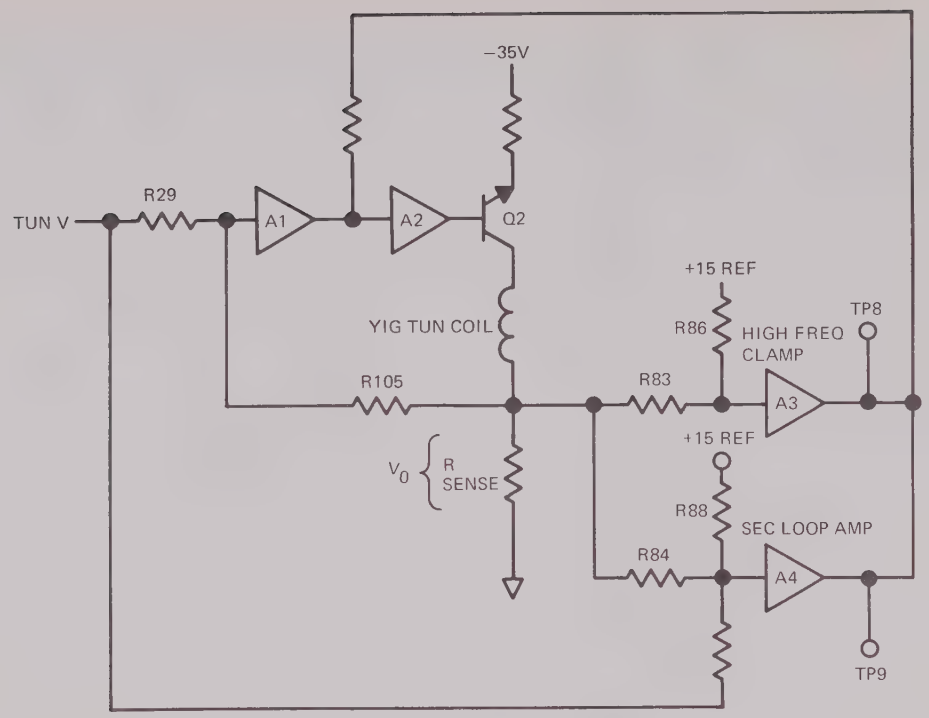


Figure 4-3. YIG Tuning Supply, Simplified Schematic Diagram

At all other values of V_0 the output from Amp 3 is zero. In this way, when the YIG tuning coil current limit is exceeded, the main feedback loop is rendered ineffective by the feedback loop consisting of Amp 2, Q2 and Amp 3. This clamping feedback loop uses as its reference, the +15 volt supply via R86 and its action is to maintain V_0 constant, independent of the increased level of the input tuning voltage.

4.3.1.1 Dual Feedback Loop

When exceedingly fast waveforms are presented at the input of the YIG tuning supply, this high gain, but relatively narrowband, feedback amplifier circuit will experience non-linearities caused by slew rate limitation in one or more of its stages. The resulting distortion in the output and the subsequent recovery time delay would present frequency shifts and calibration inaccuracies beyond the limit of the specification. This problem is particularly severe in multiband operation.

To eliminate this type of distortion, a secondary loop amplifier (Amp 4) is used which functions in a manner not too dissimilar from the amplifier used in the high frequency clamp. It should first be pointed out that the slew rate limiting exists only in Amp 1. With this in mind, the input to Amp 4 is the difference between the input tuning voltage and the output V_0. When these two signals are in perfect synchronism, there is no output from Amp 4. When there is distortion, the output V_0 does not follow the input and a net signal appears at the input to Amp 4. The output of Amp 4 is fed to Amp 2 in the same way as the high frequency clamp circuit and thereby removes Amp 1 from the feedback loop. The new loop consisting of Amp 4, Amp 2 and Q2 takes control and causes the output V_0 to once again follow the input tuning voltage waveform. This secondary loop has a wider bandwidth (faster response) and responds with no slew rate distortion. It does, however, have a lower loop gain and would not be desirable for use when long term stability (drift) is important. This is taken care of automatically since the secondary loop is only active during the transient interval

when the main loop cannot cope with the rapid change required of it. Once the fast waveform has passed, loop control is returned to the high gain, high stability main loop.

4.3.1.2 Sweep Delay Compensation

The frequency of a YIG tuned oscillator is tuned by changing the magnetic field in which the YIG material is located. The magnetic field is generated by an electromagnet driven by a current source.

Let us assume a perfect current driver, that is, one which will produce a current sawtooth in perfect synchronism with the sawtooth tuning voltage. We would expect the output RF frequency to be in perfect synchronism also. In fact, however, this is only true at slow sweep rates and is not realized at high sweep rates because of eddy (induced) currents in the magnetic material of the electromagnet. We find that as the sweep speed is changed, the linear relationship between RF frequency and tuning coil current is distorted, and produces a frequency shift as seen on the displayed response. The effect is, therefore, most noticeable at high sweep speeds and is a particular problem in multiband systems where an entire octave must be swept in only a fraction of the time available for the full sweep.

Since this sweep delay distortion is not inside the closed loop of the YIG tuning supply, a compensation signal must be introduced and combined with the tuning voltage signal. The combination of these two signals comprise a distorted input which is time sensitive and non-linear in exactly suitable proportions that will result in a linear, and sweep time independent, relationship between the output frequency and the linear sawtooth sweep voltage.

The circuit used to provide the compensation signal is shown schematically in Figure 4-4. The essential characteristic of the compensation signal can be seen in the waveform at TP6. There is

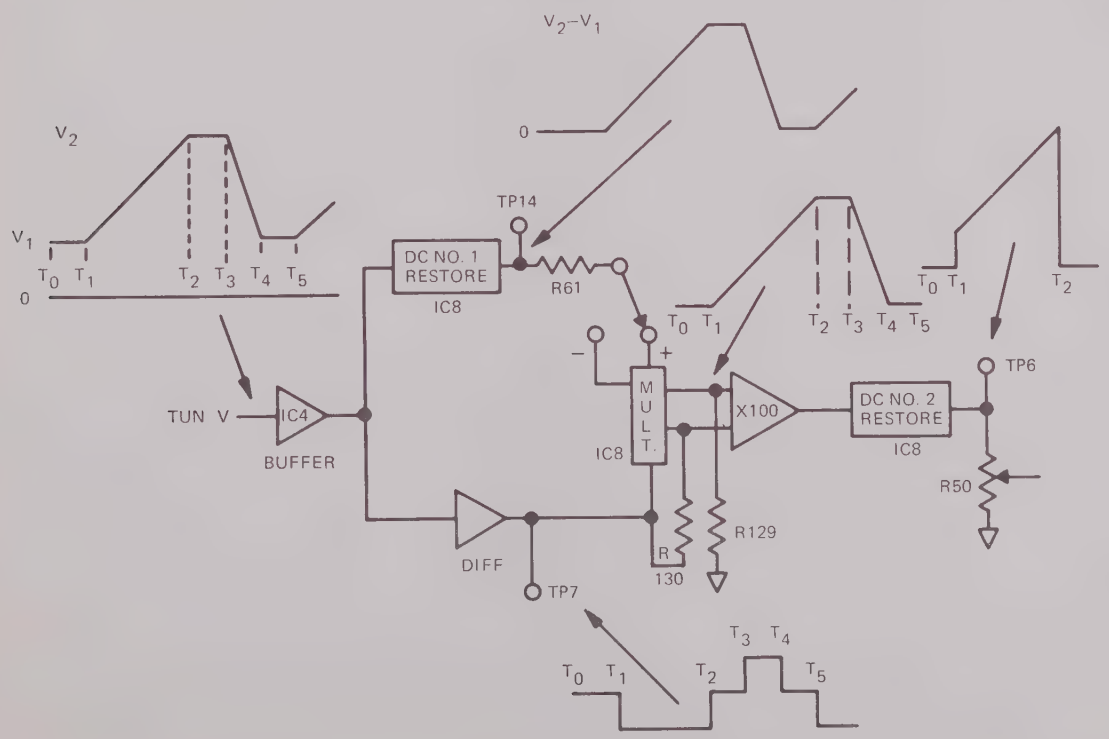


Figure 4-4. Sweep Delay Compensation, Simplified Schematic Diagram

a step component summed with a ramp component. The step is formed by differentiation of the input sawtooth and feeding the resulting step to TP6 via IC4. The ramp component is generated by multiplying the DC restored tuning voltage sawtooth with the output of the differentiator. This signal is combined with the step in IC4 and the combined signals appear at TP6. As the sweep rate is varied, the value of the derivative changes. This results in an increase in step height and an increase in ramp slope with increase in sweep speed.

To adjust the circuit for exact compensation, R61 is selected to provide the correct ramp slope and R130 and R129 are selected to provide the correct step amplitude. R130 must always be equal to R129.

DC restorer circuits are used so that the sawtooth compensation signal can be set to 0 volts at the beginning of sweep independently of the DC level present in the input tuning voltage signal. The DC level at the input is a function of the setting of the F1 control. Typically, it is at some frequency other than the low end of the band.

The compensation signal is combined with the tuning voltage signal at the input stage of the YIG tuning supply, Q8.

4.3.1.3 Automatic Tuning Supply Bandwidth

In normal operation in the swept mode, and at maximum sweep speed, the full bandwidth of the tuning supply is required so that there is no undesired distortion of the linear sawtooth drive signal to the RF oscillator. At slower sweep speeds and in the CW mode the bandwidth requirement is reduced because of the slow tuning waveform. If the bandwidth is reduced the amplitude of the noise on the tuning signal will be reduced in proportion to square root of the bandwidth, and thereby reduce the residual of FM on the RF output frequency.

In the 430A Series of RF Units, the tuning supply bandwidth is automatically controlled in accordance with the sweeping rate used by the operator. A simplified diagram of this circuit is shown in Figure 4-5. The bandwidth is determined by R105 and the capacitance C29 or the parallel

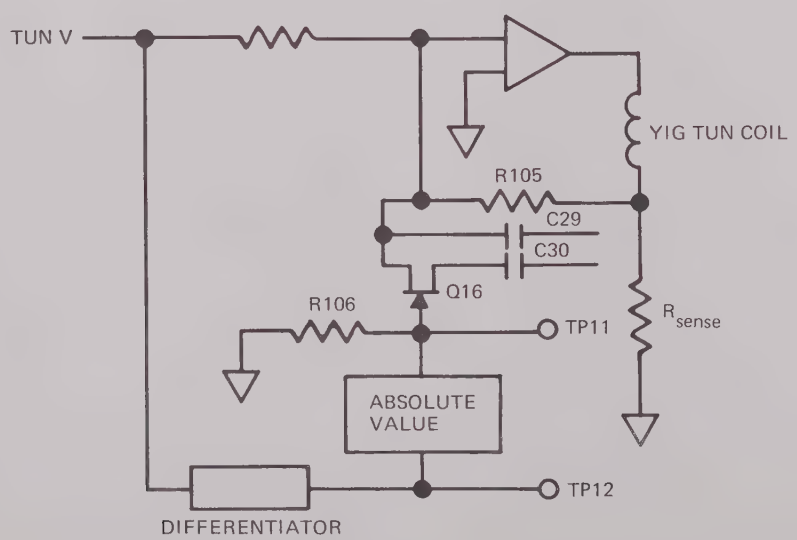


Figure 4-5. Automatic Tuning Supply Bandwidth, Simplified Schematic Diagram

combination of C29 and C30. The maximum bandwidth occurs when Q16 is an open circuit and the minimum bandwidth occurs when Q16 is a short circuit.

The state of Q16 is controlled by the absolute value generator circuit which in turn is supplied with the derivative of the tuning voltage. It can be seen, therefore, that at sufficiently high sweep rates, the derivative will be large enough in amplitude to cause Q16 to open circuit and thereby increase the bandwidth of the tuning supply.

The differentiator is shown in Figure 4-6 where C27 and R97 determine the differentiating time constant. The Zener CR35 is combined with the diode bridge circuit in the feedback path to limit the maximum positive or negative amplitude at the output of the differentiation.

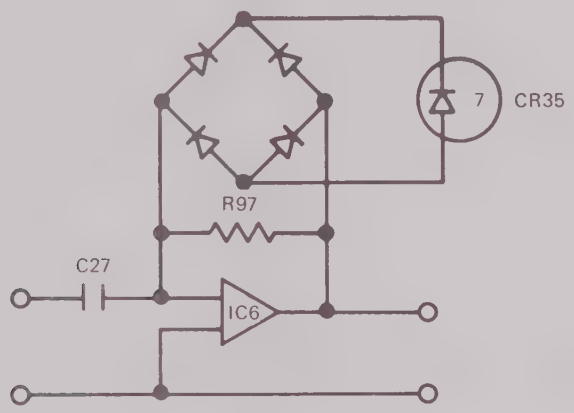


Figure 4-6. Differentiator, Simplified Schematic Diagram.

The absolute value generator is shown in Figure 4-7. Amplifier A1 is an operational summing amplifier providing the sum of two signals:

1. The input V_1.

2. The output V_2 from amplifier A2.

The values of circuit resistance are such that if V_1 is negative the gain of A1 via R94 is twice the gain via R93 and the resulting output is equal to $-V_1$. When V_1 is positive, amplifier A2 is eliminated by virtue of the diodes in its feedback path which reduce its output to 0 volts when the input is positive. Hence, only A1 is operative and the output is again equal to $-V_1$.

4.3.1.4 Varactor Tuning Supply

The voltage vs. frequency curve for the varactor tuned oscillator is non-linear and it requires a "distorted" sawtooth drive in order to compensate and thereby provide a linear overall voltage vs. frequency relationship. The "distortion" or shaping is done in the same operational amplifier used as the tuning supply.

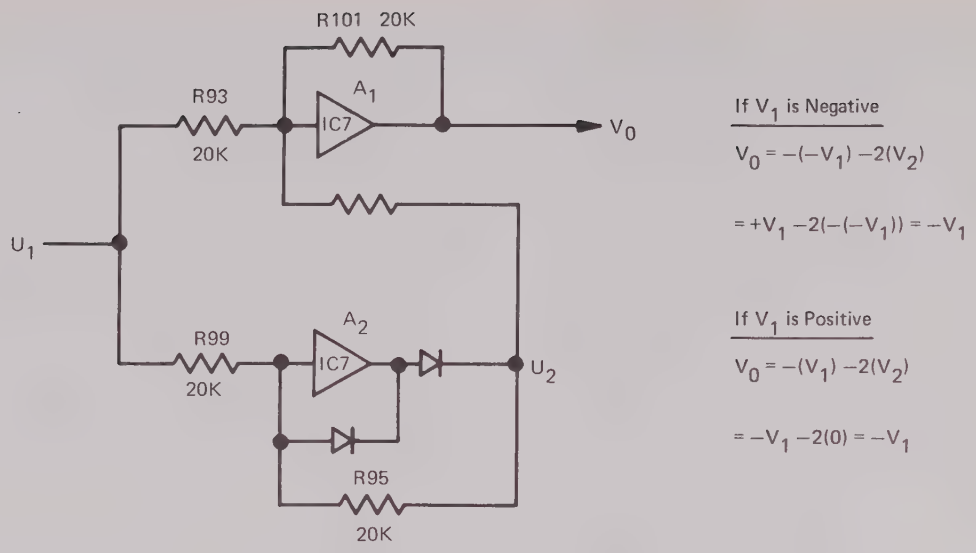


Figure 4-7. Absolute Value Generator, Simplified Schematic Diagram

A simplified non-linear amplifier is shown in Figure 4-8. A linear sawtooth signal, V_1, at the input results in a linear current I_1 which also flows through R2. With the increase in instantaneous value of I_1 the potential at the junction of R2 and R3 increases until CR1 is forward biased and conducts current I_4. The resulting output current $I_3 = I_1 + I_4$ and output voltage $V_0 = -(I_1R2 + I_1R3 + I_4R3)$ as illustrated in Figure 4-8B are non-linear.

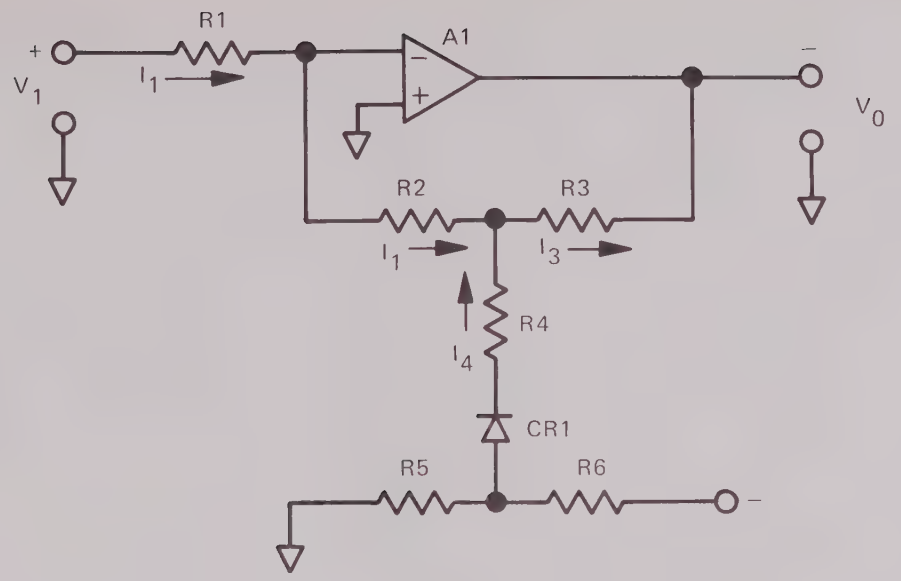
This technique is expanded with the use of many diodes and can provide an essentially smooth curvature in the non-linear shaping.

A more detailed schematic of the tuning supply is shown in Figure 4-9. Here the shaping network is augmented with transistor Q10 which is used to introduce a segment of reverse curvature by reducing the effective output voltage when a sufficiently negative potential exists at the junction of R45 and R38. At that time Q10 conducts and shunts R45 with resistor R26. Since the output voltage is a function of the voltage drop across R45, the action of Q10 causes a reduction in the rate of increase in output voltage.

This reverse curvature is used to correct for corresponding reversals of curvature in the varactor oscillator's tuning characteristic.

A high voltage pre-regulator is used and consists of a constant current generator, Q6 and CR38, driving Zener CR39. Transistor Q9 is used as an emitter follower to supply the high current requirements of the output stage.

In the actual circuit, additional transistor stages Q4, Q13 and Q19 are used to provide current and voltage limiting where signal transients would otherwise cause undesirable non-linear distortions.



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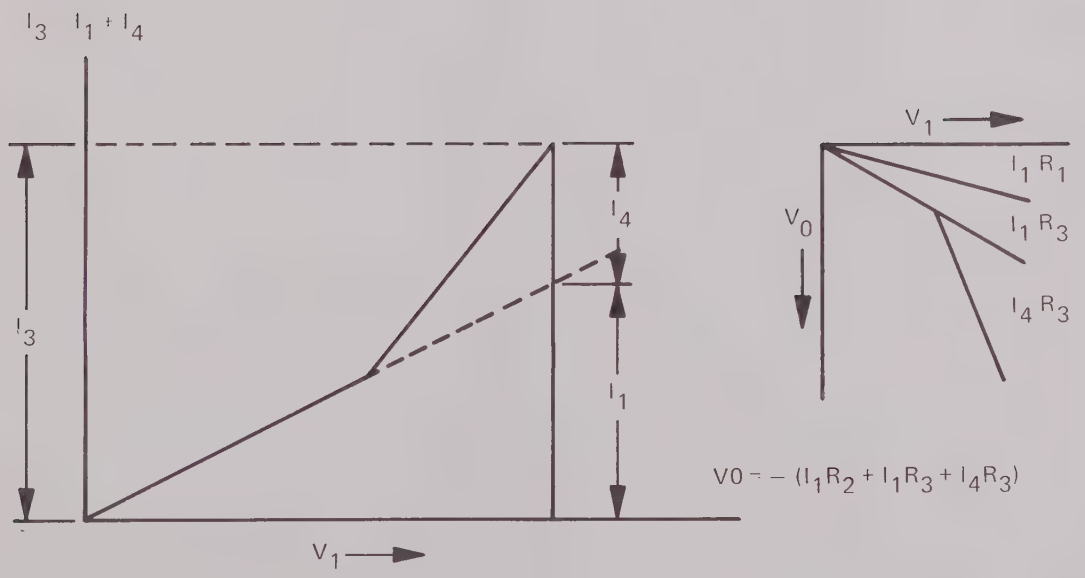

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Figure 4-8. Simplified Non-Linear Amplifier

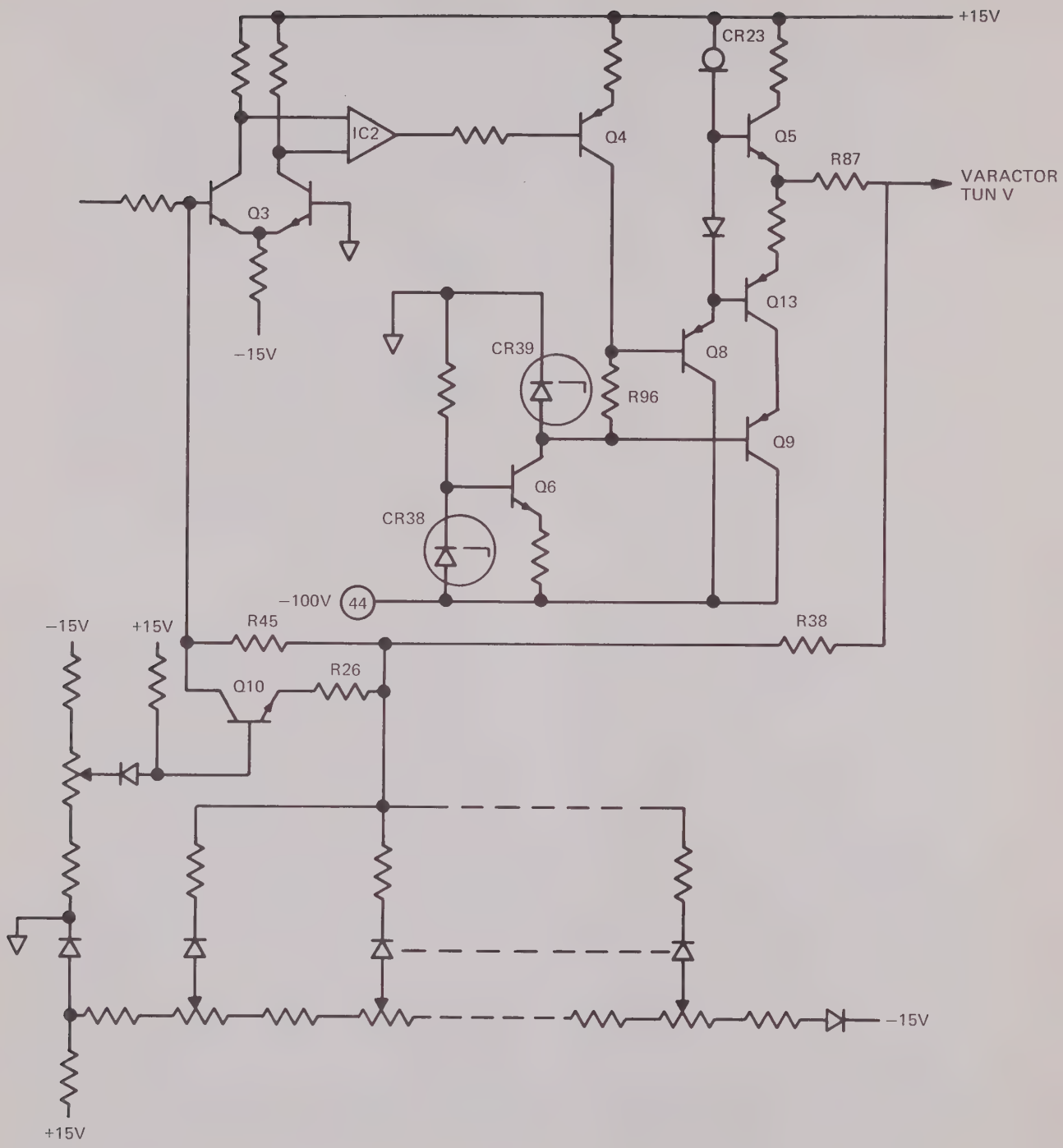


Figure 4-9. Varactor Tuning Supply.

4.3.2 Leveling Circuit

The leveling circuit controls the amplitude of the RF output. In the leveled mode, the amplitude is maintained constant as the RF frequency is swept across the band. In the unleveled mode, the normal variation in RF source amplitude will be present at the output.

In the leveled mode, a feedback amplifier is used consisting of a high gain amplifier, RF diode modulator, directional coupler and RF detector. This circuit is shown as a simplified block diagram in Figure 4-10.

The forward path consists of all the elements described above and the feedback path is amplifier A1. It can be seen, therefore, that the function of the leveling amplifier is to maintain the voltage at the output of amplifier A1 constant and proportional to the reference RF level control setting. Since the transfer characteristic of amplifier A1 is constant and independent of RF frequency and RF amplitude, the output of the crystal detector is kept constant and proportional to the reference RF level control setting.

If the transfer characteristics of the directional coupler and crystal detector are independent of RF frequency over the band of interest, then the loop will adjust the attenuation of the diode modulator so that the amplitude of RF output will be constant as the RF frequency is swept across the band.

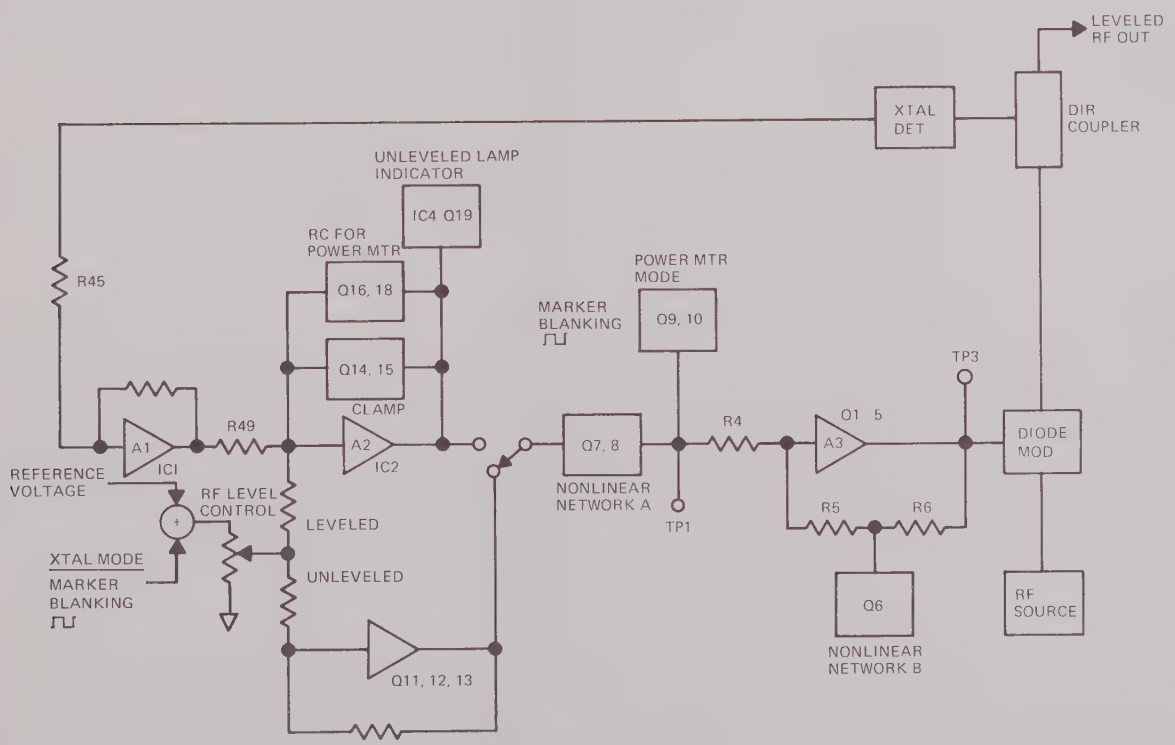


Figure 4-10. RF Leveler Simplified Block Diagram

4.3.2.1 Linearized Loop Gain

The operation of leveler described so far assumes that the loop is stable and that there are not excessive variations in forward loop gain. In normal use, however, the change in RF level control settings causes the RF output level to change over a sufficient dynamic range (in excess of 10 dB) that the square law characteristic of the Xtal detector, and the non-linear transfer characteristic of the diode modulator cause excessive variation in forward loop gain. This gain variation gives rise to the following dilemma.

If the closed loop bandwidth is high enough at the high gain conditions in the loop to provide the desired rise time for the leveler, the closed loop rise time will be inadequate when the loop operates at the low gain conditions. On the other hand if the loop gain is increased so that adequate closed loop bandwidth is obtained at the lower gain conditions, then when the loop operates at the high gain conditions there will be excessive phase shift in the loop resulting in overshoots, ringing or even loop oscillation. In the past, sweeper manufacturers provided a front panel "loop gain" control and required the operator to optimize the loop gain for the particular operating RF level. In the 430A leveler, a combination of non-linear networks are included to cancel the non-linearities of the diode modulator and Xtal detector, and thereby provide uniform rise time for all RF level settings without overshoots or ringing on the output RF waveform.

The A2 amplifier contributes the most gain to the loop and as a result requires special care when the leveler is required to turn RF power on or off under the control of fast waveforms such as pulse modulation, blanking, etc. When the control signal directs the RF to be turned off, there is no signal returned from the Xtal detector and the feedback loop is effectively opened. With this loss in control, the A2 amplifier will saturate and the capacitors used for phase shift stabilization will charge to the supply voltage. If, at this time, the control signal directs the RF to be turned on to a specified level, the loop will remain open until the charged capacitors discharge to the normal operating levels. This will cause a delay in the output RF turn-on waveform and also generate a recovery transient that will distort the output.

To overcome this problem, a clamp circuit consisting of Q14 and Q15 is biased so that they conduct when the output of IC2 exceeds the limits of ± 4 volts. This controls the output swing of IC2 to a value that does not introduce any significant delay or transient distortion.

4.3.2.2 Power Meter Leveling

When the RF detector used for leveling is a power meter using a thermistor transducer, the stabilization of the leveling loop must be modified. The thermistor element has a slow response time and thereby introduces excessive phase shift in the feedback loop resulting in loop oscillation. To avoid this, a stabilization network shown in Figure 4-11 consisting of C28 and R42 is introduced by switching Q18 on or off via Q16. With the modified loop stabilization, the response time of the closed loop is drastically reduced to the order of *seconds.* This response time is perfectly compatible with the power meter which is essentially dictating the entire loop response. The operator must, however, be sure to limit the sweep time (sec) selector to the region between 10 and 100 seconds because the RF frequency sensitive variation will not be removed at the higher sweep rates.

The level modulation by the RF markers, square wave, and blanking waveforms from the "on" circuit in the 430A mainframe is introduced after the slow responding amplifier via Q9 and Q10. The response time of the leveling loop is too slow to follow the 1 KHz square wave modulation and therefore the average power of the modulated waveform will be regulated. Since the duty factor is 50%, the peak power with square wave modulation will be twice the average power. RF DURING RETRACE should be left ON for best results when power meter leveling.

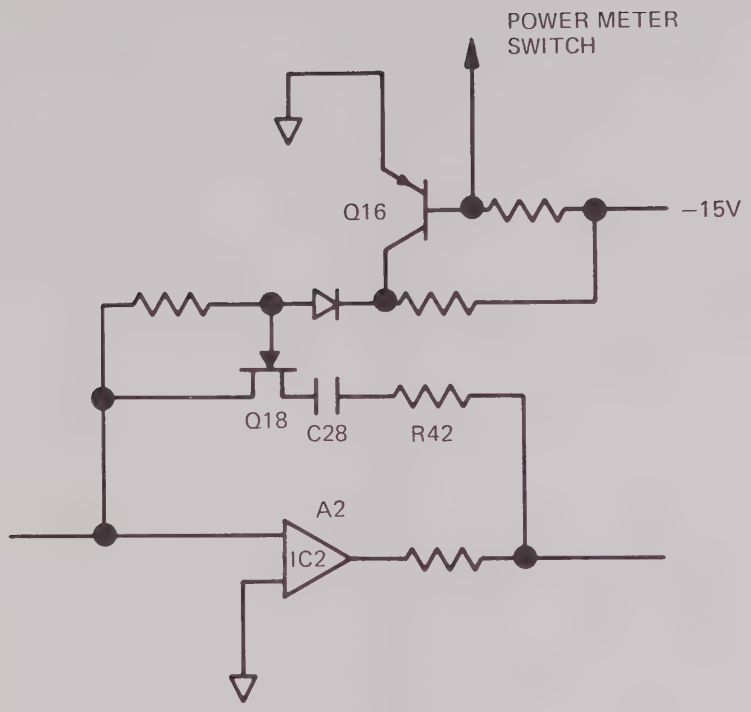


Figure 4-11. Power Meter Leveling Stabilization Network

4.3.2.2.1 Gain Control - Power Meter Leveling

When the range setting on the power meter is changed, and for example assume it is reduced (lower power level), the leveling feedback loop operates to cause the needle on the power meter to remain stationary. The meter reading is equivalent to the signal output used to complete the feedback path and, therefore, the leveling loop must reduce the RF power into the power meter at the lower range setting. Under this circumstance consider the effective transfer gain of the power meter. Since its output is constant with a reduction in input power, the gain of the power meter is increased. It can be seen, therefore, that the leveling loop gain is a function of range setting of the power meter. It is necessary to provide a gain control for the operator to optimize the loop gain over the range of settings used on the power meter. This control is a front panel screwdriver adjustment R4 and *is operative only in the power meter leveled mode.*

4.3.2.3 Auto Polarity Circuit

The leveling circuit normally operates with a specific polarity at the output of the RF detector. In some equipment a switch is provided to adjust the circuit configuration when this polarity is changed. In the 430A RF Units a circuit is included which automatically does the switching described above when the polarity of the detector is changed. This means that for either the "Xtal" or the "power meter" mode the leveling circuit will automatically adjust to either polarity used.

A simplified block diagram of the circuit that controls this operation is shown in Figure 4-12. The input to A1 is controlled by a DPDT relay which changes the polarity of its gain. The output of A1 is sensed by a comparator circuit which will produce a transition when the level at TP 4 exceeds a specified value and polarity. This level is exceeded (+0.15 volts) when the wrong polarity occurs at the input and the loop attempts to increase the RF output. The transition turns on both the multivibrator, which oscillates at a few cycles per second, and the gated flip-flop which is also driven by the multivibrator. The output of the flip-flop drives a binary relay driver.

One state of the multivibrator will set the realy contacts to a position which is correct and the output of A1 will go negative. This condition will remove the transition at the output of the comparator and the leveling loop will then operate normally.

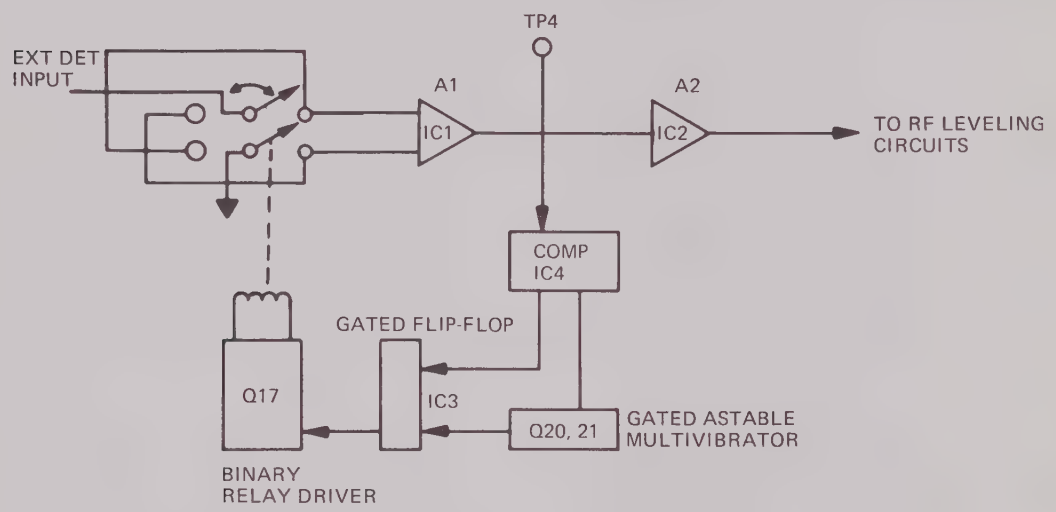


Figure 4-12. Auto Polarity Circuit, Block Diagram

4.3.2.4 Amplitude Modulation

All control of the RF amplitude is done via the RF Diode Modulator and its control circuit, the Leveler. In addition, to any external AM input signals, the internally generated signals are combined in the leveling circuit to form one composite amplitude modulated waveform. These signals include: frequency markers, retrace blanking, square wave and corrective leveling signals.

In the leveled mode, all of these signals are combined linearly in the operational amplifier that defines the leveling loop. If the reference crystal detector used in leveling is operated in its linear range, the output RF Amplitude will be linearly modulated with the input AM signal. If the reference crystal detector is operated in its square law region, the output RF POWER will be linearly modulated also.

4.3.3 Bias Supply

The Bias Supply furnishes the power to the Gunn Diode or Transistor in the RF oscillator, as may be the case in a particular RF Unit. A simplified schematic diagram is shown in Figure 4-13. The supply shown here is a "POSITIVE OUTPUT" configuration used in those RF Units which require a positive voltage with respect to ground for its bias supply.

In some RF Units, a heater supply is also required where the heater voltage is higher than the bias voltage. This dual supply is obtained from terminals W and V. The regulator operates to control the potential at terminal V and the Zener CR47 provides a sufficiently accurate and stable voltage increase above the bias voltage to meet the requirements of the heater.

The regulator is a typical operational amplifier configuration with R8 being the feedback resistor and the series combination of R9 and R19 being the input resistor. The amplifier gain is the cascade combination of IC1 and Q1 (located on the RF Unit mainframe).

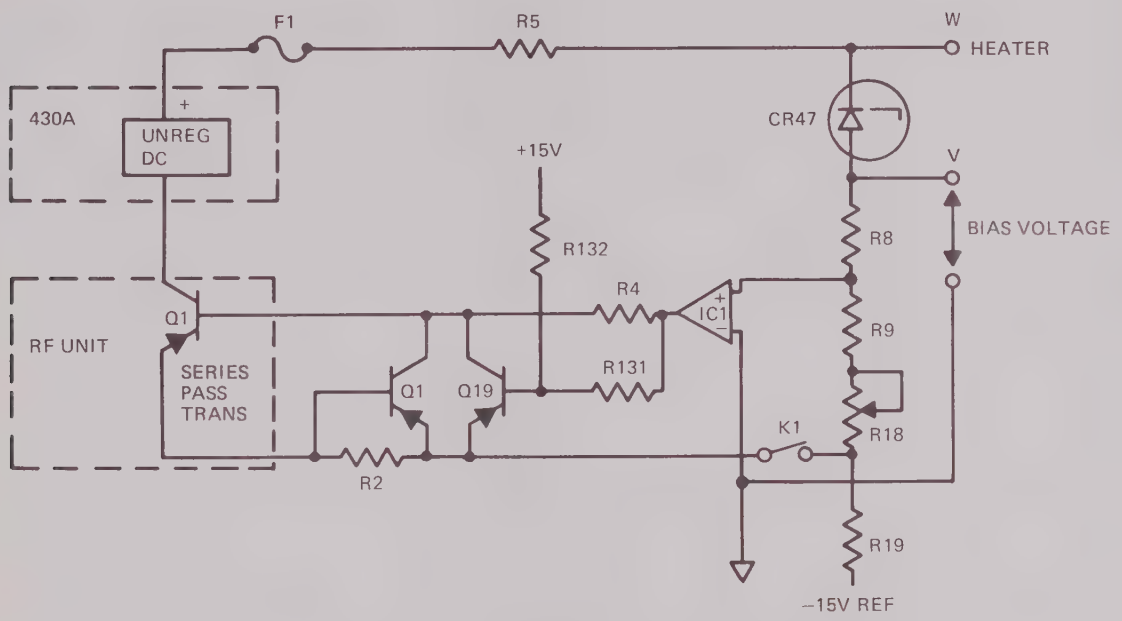


Figure 4-13. Bias Supply, Simplified Schematic Diagram

4.3.3.1 Protective Circuits

To prevent damage to the RF oscillator source, a number of protective circuits have been included in the design of the bias supply. These circuits, in many cases, are redundant, however, the higher replacement cost of the RF oscillator more than justifies this precaution.

4.3.3.2 Inhibiting Delay

When the AC power is first applied, as during a normal equipment turn on, the sequence of turn on for the + and −15 volt supplies is uncontrolled. As a result, the output of the bias supply could overshoot the desired value during the time interval between power on and stabilization of the + and −15 volt supplies.

To prevent overshoot, Q19 is wired in shunt with the drive to the output series regulator. In normal operation, the output of IC1 is negative and Q19 is biased off causing it to have no effect on the operation of the bias supply. Assume that the −15 volt supply is on before the +15 volt supply reaches its final value. Under this circumstance the output of IC1 will be negative and keep the output series regulator cutoff and the output of the bias supply will be zero. If we next assume that the +15

volt supply is on before the −15 volt supply, Q19 will be biased "on" via R132 causing any drive current to the output series regulator to be shunted through Q19 and the output of the bias supply will be zero.

As the lagging supply voltage reaches its normal level, the bias supply will smoothly rise to its normal level with no overshoot.

4.3.3.3 Current Limiting

The current limiting circuit consists of transistor Q1 and resistor R2. As the bias supply load current exceeds the desired load current, the voltage drop across R2 increases in a direction which causes transistor Q1 to conduct thereby shunting the drive current to the series pass transistor. This action causes the output bias supply voltage to drop to a level that will maintain the load current constant and equal to the level set by the selection of the value of R2.

In the actual circuit, a feedback network is applied to the current limit transistor Q1 via R1 and R3 to generate a foldback characteristic that will cause the load current to stabilize at a much lower value after the current limiting circuit has been actuated. This feature reduces the power dissipated in the series pass transistor if the output of the bias supply remains short circuited for an indefinite period of time.

4.3.3.4 Fuse

If circuit components of the current limiting circuit should fail, and an increase in load current occurs, fuse F1 is designed to blow and thereby protect the RF Source.

4.3.3.5 Crowbar Circuit

The crowbar circuit is illustrated in Fig 4-14. Its purpose is to provide protection to the RF Source in the event that the bias supply voltage exceeds a safe level. In operation, the SCR CR7 is

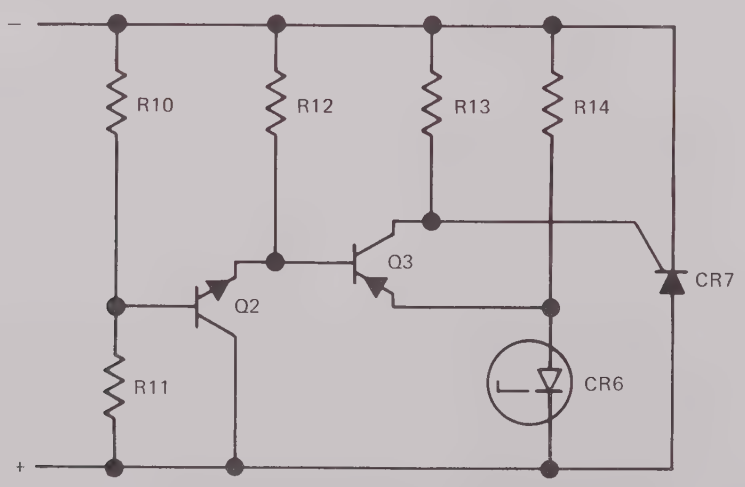


Figure 4-14. Crowbar Circuit

fired and produces a short circuit across the bias supply thereby reducing the bias voltage to zero. A reference voltage developed by Zener CR6 is compared with a sample of the output of the bias supply in transistor Q3. As the bias supply voltage increases, the base of Q3 becomes more negative until it is more negative than its emitter at which point, Q3 conducts and CR7 is fired. The critical level at the base of Q3 is set by the value of R10.

4.3.4 FM Input Circuitry

The method for providing a direct-coupled wideband FM input is shown in Figure 4-15. The input signal is frequency multiplexed via a high pass and low pass filter which, in turn, feed the modulation signal frequency components to the FM coil and the main tuning coil, respectively.

The FM coil is a special winding in the YIG tuning structure which has an air core and operates at high frequencies. The air core has lower "core loss" at higher frequencies and thereby provides wideband performance. The lower permeability of air compared to the iron core reduces the flux density for a given magnetizing current and for this reason the FM coil cannot cause large frequency deviations.

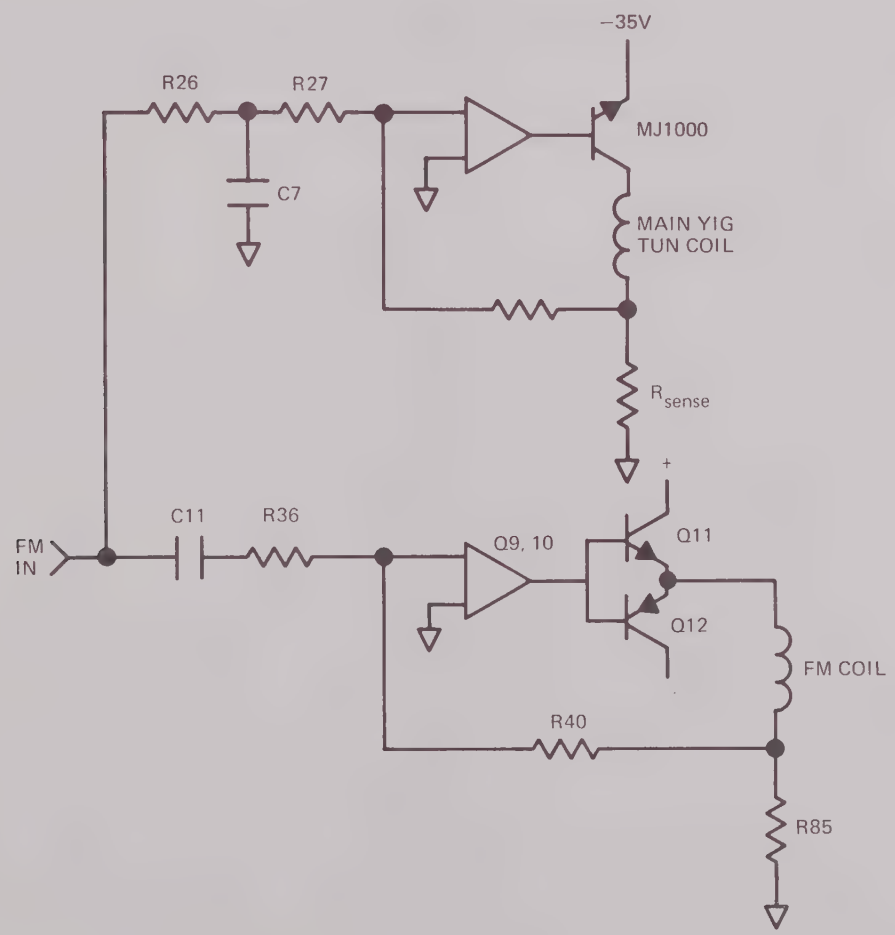


Figure 4-15. FM Input Circuitry

4.3.5 Heat Exchanger

In the higher frequency bands and for YIG tuned RF sources, the tuning current and consequently the power required for tuning this source is quite high (i.e., 30 - 50 watts). To avoid dissipating all of this power in one series pass transistor and cause intensive heat dissipation in one location, some of the tuning current is supplied by Q2 as shown in Figure 4-16.

Transistor Q2 is the heat exchange sink and is located as far away from the series pass transistor as is practical. In operation, the current required at the low end of the tuning range is supplied by Q2 and as current is required with increasing RF frequency, it is furnished via the series pass transistor.

The transistor Q1 is used to control the heat exchange circuit and shut it off when the RF Unit is in standby in multiband operation. The control signal is the presence or absence of the −15 volt supply to R1.

4.3.6 Remote Tuning

The remote tuning input signal is summed algebraically via R28 with all other tuning signals in an operational amplifier called the tuning supply. These inputs are always active and the user must,

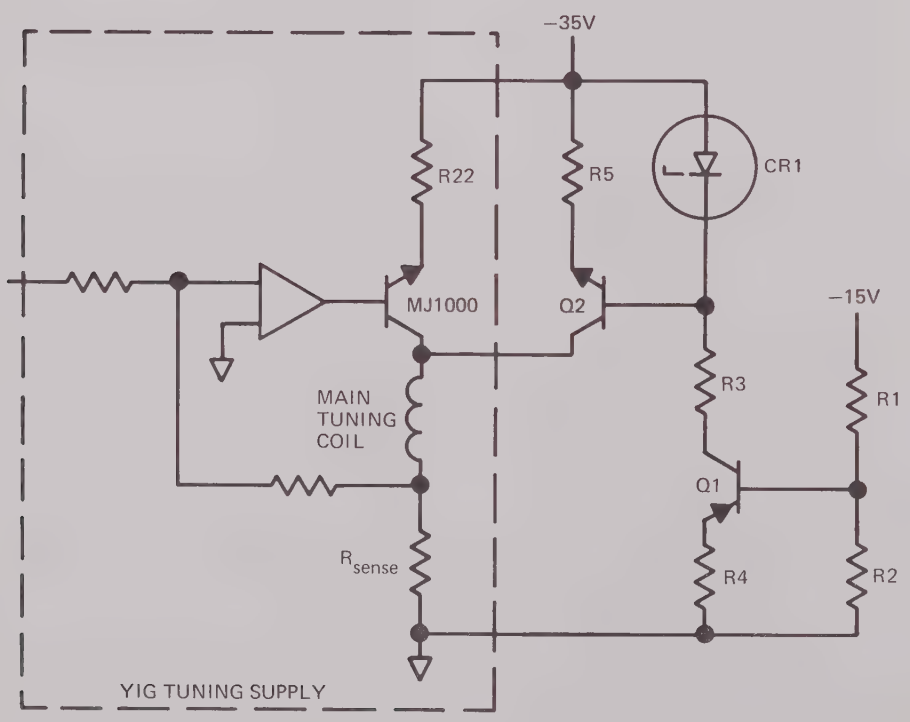


Figure 4-16. Heat Exchanger Circuit

therefore, be sure that the other controls are set in their appropriate positions to either combine with the remote signal or not interfere with the remote signal.

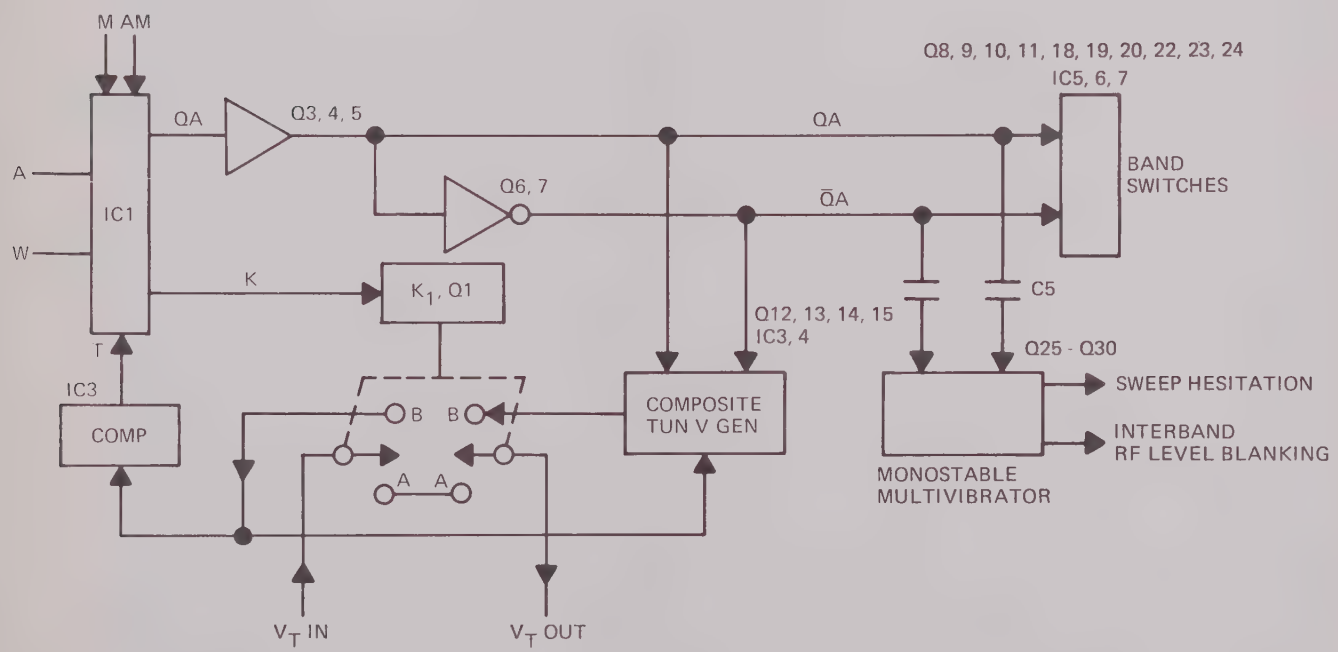
For exclusive control of the tuning supply by the remote tuning signal, the model 430A controls should be set as follows:

Control	Setting
SWEEP FUNCTION	EXT/M1
M1	Fully CCW

4.3.7 Remote ON/OFF

The remote on/off function is intended to reduce the RF output to absolute zero without adjusting any other controls or removal of AC line power. This is done by reducing the bias supply voltage to zero which will stop RF oscillations in the RF source.

A relay controlled switch, K1, is used to set the reference for the bias supply to zero, as shown in Figure 4-17.



V_T (IN) = TUNING VOLTAGE FROM 430A MAINFRAME
V_T (OUT) = TUNING VOLTAGE TO RF OSCILLATOR

Figure 4-17. Block Diagram of Control Logic

4.3.8 Heterodyne Unit Control Logic (438A)

The dual range of the 438A RF Unit can be used either one at a time or in a multiplexed sweep where the 10 MHz - 1 GHz range is displayed continuously with the 1 - 2 GHz range providing a full 10 MHz - 2 GHz presentation in a single sweep. This multiplexed sweep is referred to as the WB (Wide Band) mode. A block diagram of the control logic for this system is shown in Figure 4-17.

IC1 provides the combinatorial logic shown in Figure 4-18.

The output signals QA and K are used to control all switching and gating circuits.

The combination of signals that result in K = 1 will set the DPDT switch K1 in position A-A and disconnect the input signals to the comparator and composite tuning generator circuits. The QA signal will position the band switches as described in Paragraph 4.2.1 and the block diagram in Figure 4-2. In this manner the 10 - 1000 MHz or the 1 - 2 GHz range can be selected.

It should be noted that when the 438A is plugged into a 4310A/K multiband system (M = 0) range selection is made via a control signal A_m received from the 4310A/K.

When the Wide Band or multiplexed sweep is selected either manually by means of the front panel selector or via the remote signals, the value of K is 0. This condition will set the DPDT switch K1 in the position B-B and connect the VT (IN) signal to the inputs of the comparator and composite

Figure 4-18. Combination Logic

Mode Switch			Input			Output	
	A	W	T	A_m	M	Q_A	K
For All Positions	X	X	X	A_m	O	A_m (±5V)	1
.01 - 1 GHz	1	0	X	1	1	–5V	1
1 - 2 GHz	0	0	X	1	1	+5V	1
W. B.	1	1	T	1	1	T (±5V)	0
Remote .01 - 1 GHz	1	0	X	1	1	–5V	1
Remote 1 - 2 GHz	0	0	X	1	1	+5V	1
Remote W.B.	1	1	T	1	1	T (±5V)	0

Notes: 0 = ground potential
1 = open circuit or +5V
X = can be either "0" or "1"
T = Logic level at output of comparator

When 438A is plugged into a 4310A Multiband System:
A_m = Logic level from 4310A Multiband Control Unit
M = Logic level from 4310A = 0

tuning voltage generator circuit. The QA signal will not respond to the Signal T which is the output of the comparator circuit. It can be seen therefore, as the output of the comparator changes state, first one band and then the other band will be selected.

The composite tuning voltage generator is not keyed by the QA signal to generate a waveform suitable to tune the RF oscillator so that the RF frequency will be synchronous with the multiplexed display.

At the time that the comparator output changes state, many circuit functions are triggered simultaneously, some of them are not able to respond instantaneously. In order to avoid non-linearities and recovery transients from being displayed, a swell is generated and the sweep is stopped for a short time interval to allow the circuits sufficient time to recover.

It should be noted that when the 438A is used in the 430A mainframe, the WIDEBAND mode (.01 - 2 GHz) will not operate properly unless the jumper between pins 4 and 5 of the Jones strip on the rear panel of the 430A is removed.

4.3.9 Timing Waveforms

The sawtooth generator in the 430A begins its cycle and proceeds normally until the comparator in the 438A is triggered and changes state. This condition triggers the monostable multivibrator and causes a signal on the sweep hesitation lead to interrupt the sawtooth generator and stop the sweep for the duration of the sweep hesitation signal. Figure 4-19 illustrates the relative timing of these signals.

Synchronous with the triggering of the comparator, the V_T (out) signal is abruptly returned to 0 and remains there for the duration of the dwell. At the end of dwell, the sweep resumes and the V_T (out) signal begins a new sweep cycle.

The relationships among the various signals are combined on one chart in Figure 4-20 to show how time, horizontal sweep voltage, RF output frequency and tuning voltage to the RF oscillator are synchronized.

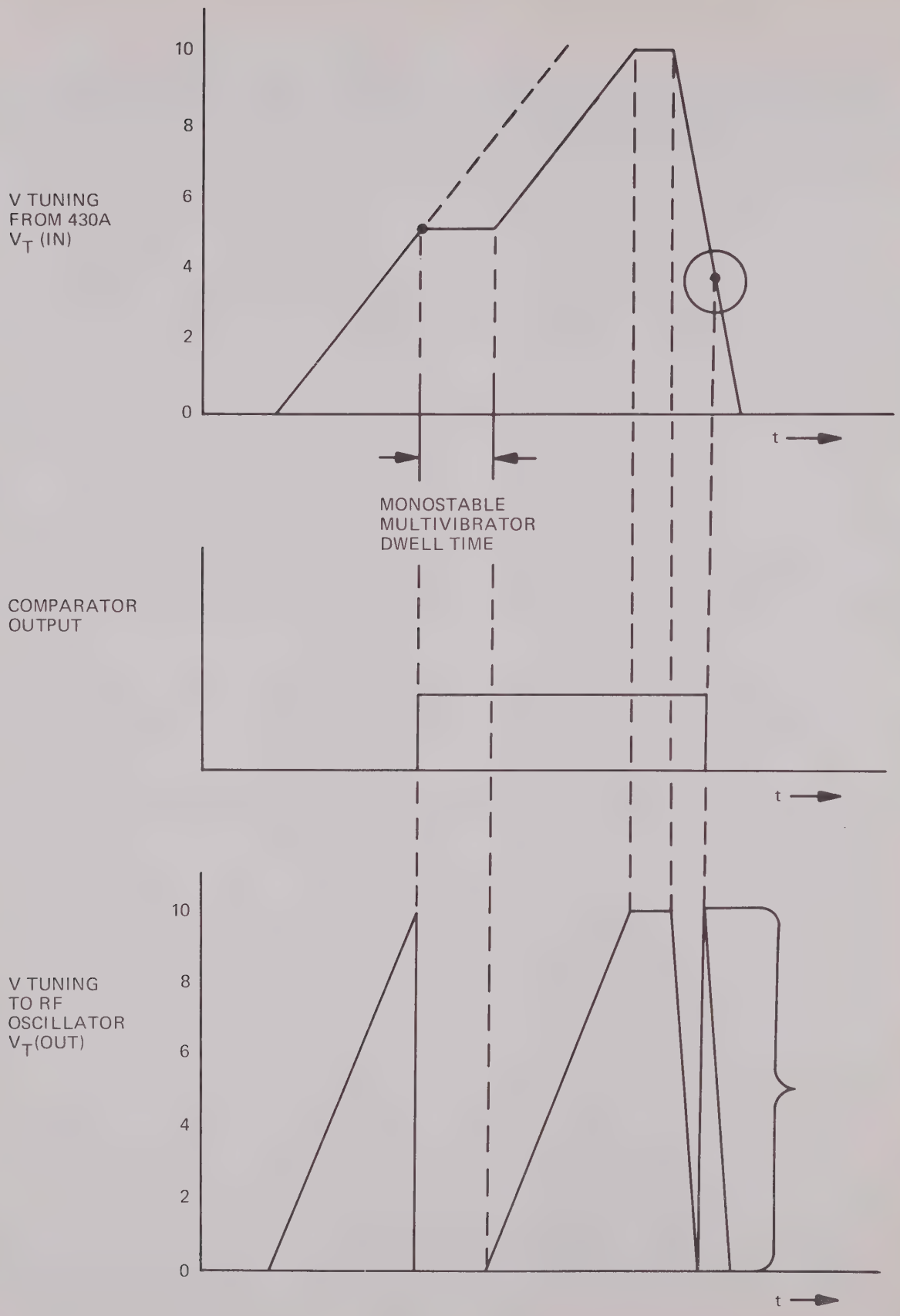


Figure 4-19. Timing Waveforms

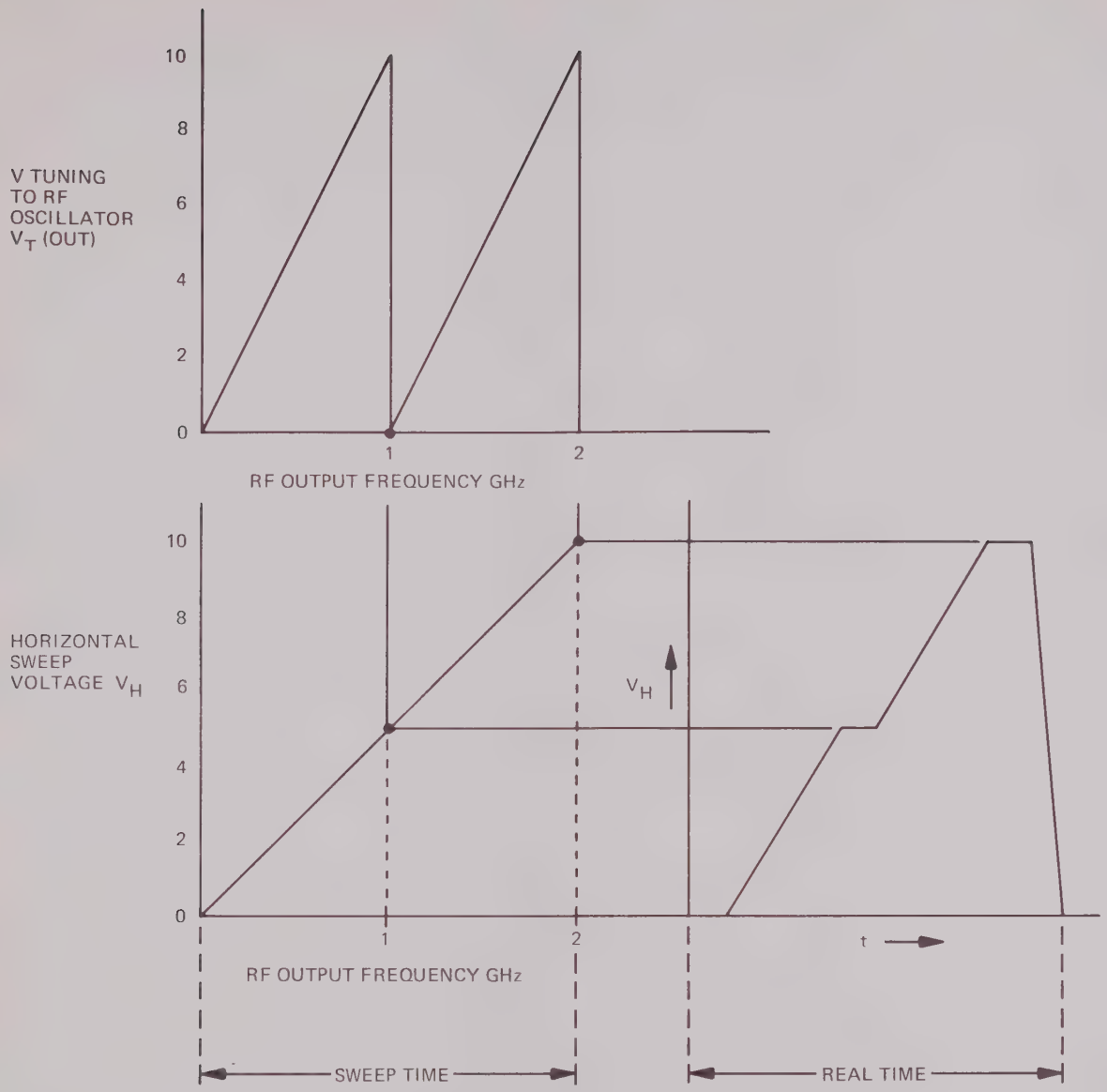


Figure 4-20. Functional Relationships

4.3.10 Comparator

The comparator circuit is shown in simplified form in Figure 4-21. When V_T (IN) is equal to 0, the net signal at the input to the amplifier is negative and the high gain of the amplifier causes it to saturate with a positive output. As V_T (IN) increases a value will be reached depending on the setting of potentiometer R47, when the net signal to the amplifier reaches zero and goes positive. In this region, the amplifier will change the polarity of its output and saturate with a negative output.

The exact value of V_T (IN) for which this transition takes place is controlled by the setting of R47 and the steepness of the transition is a function of the gain of the amplifier.

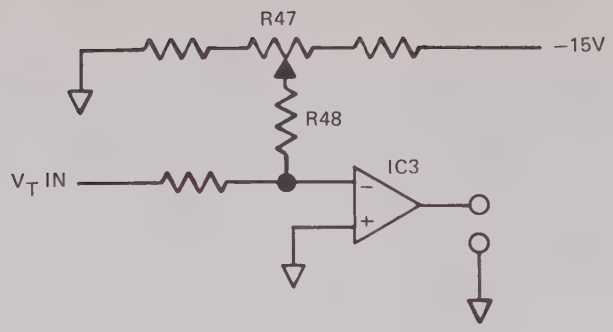


Figure 4-21. Comparator Simplified Schematic Diagram.

4.3.11 Composite Tuning Voltage Generator

The V_T (out) signal is generated by the circuit shown in Figure 4-22. Two operational amplifiers are connected in parallel and their outputs are combined in a third operational amplifier. In addition to the V_T (IN) signal, the A1 amplifier receives a bias signal from R42 and a gating signal via A4 which is an inverted and shifted version of QA. There are diodes CR4 and CR5 connected to A1 to insure that the output is always negative or zero.

A requirement of this circuit is that the full 10 volt swing of the tuning voltage V_T (OUT) be provided with the V_T (IN) signal varies over a smaller range. This corresponds to the output being an amplified version of the input. The lower limit of the output is controlled by the bias setting of R42 and the upper limit of the output is controlled by the modified QA gating signal which causes the output of A1 to return to zero when QA is present.

In a similar manner amplifier A2 is biased and gated to cause a second ramp of V_T (OUT) to occur as shown in Figure 4-19.

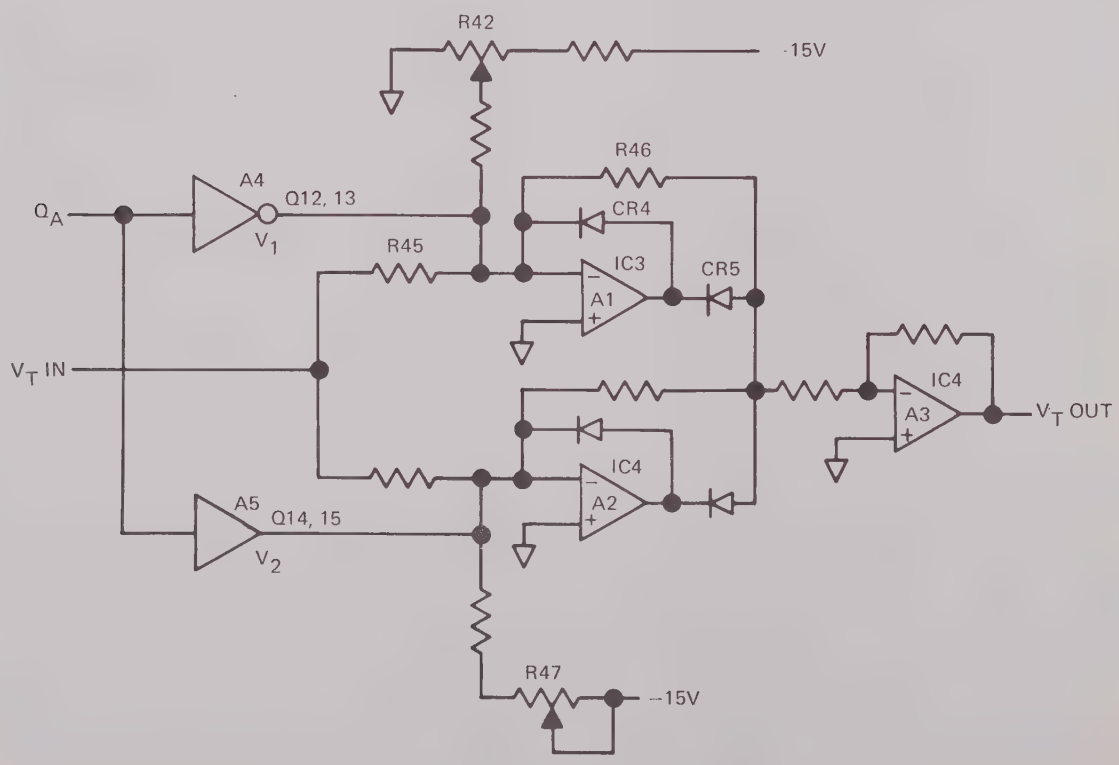


Figure 4-22. Composite Tuning Voltage Generator

SECTION 5
MAINTENANCE

5.1 INTRODUCTION

This section provides the information required to maintain and service the RF Units for the Model 430A Sweep Oscillator and contains a list of the required test equipment, a performance check and calibration and alignment procedures.

5.2 REQUIRED TEST EQUIPMENT

Test equipment other than those listed in Table 5-1 may be used if their specifications equal or exceed the required characteristics. (Use recently calibrated test equipment.) The equipment required to perform the calibration is listed in Table 5-2.

5.3 PERFORMANCE TESTS

The following performance tests are performed to verify whether the RF Unit is operating within its specifications as listed in Table 1-1. The tests should be used as part of the incoming quality control inspection, as a periodic operational check or after maintenance and service has been performed.

NOTE

The RF Unit must be installed in the Model 430A Mainframe before starting the following performance tests.

5.3.1 Frequency Accuracy

a. Connect equipment as shown in Figure 5-1.

b. Set Model 430A controls as follows:

Front Panel	
TRIGGER	LINE
MARKER AMPLITUDE	Clockwise
SWEEP FUNCTION	F1 - F2
SWEEP TIME (SEC)	.1
F1	Low Limit
F2	High Limit
1 kHz ⊓⊔	Off (down)
PUSH ON	Depress and Release

TABLE 5-1. REQUIRED TEST EQUIPMENT FOR PERFORMANCE TESTS		
Title	**Requirements**	**Suggested Manufacturer and Model No.**
Variable Transformer	at least 105 to 125 VAC 1 AMP	Superior Electric Co. 3PE116
AC Voltmeter	at least 105 - 125 VAC ±1% 48 - 420 Hz	Weston 433
Oscilloscope	Vertical: DC to at least 300 kHz	Tektronix 561A with 2A63 Differential Amp 1 and 2B67 Time Base
Frequency Meter, Reaction Type		
200 - 500 MHz	±0.1% accuracy	Narda 804
500 - 1000 MHz	±0.1% accuracy	Narda 805
1 - 2 GHz	±0.1% accuracy	General Microwave N607
1 - 4 GHz	±0.1% accuracy	General Microwave N604
4 - 8.2 GHz	±0.1% accuracy	General Microwave N608A
8.2 - 12.4 GHz	±0.1% accuracy	HP X532B with two coaxial to waveguide adaptors
12.4 - 18 GHz	±0.1% accuracy	HP P532A with two coaxial to waveguide adaptors
10 dB Attenuator Pad	Calibrated within ±0.1 dB VSWR 1.3 max	Weinschel Model 2 or 2A
RF Power Meter with Thermistor Mount		
0.2 to 8.2 GHz	±0.3 dB	HP 432A with HP 478A
8.2 to 12.4 GHz		HP X486A with coaxial to waveguide adaptor
12.4 to 18 GHz		HP P486A with coaxial to waveguide adaptor
Directional Coupler	10 dB coupling factor	
30 to 1000 MHz	20 dB directivity	Anzac DCG10
500 to 1000 MHz		Weinschel Model 1540
1 - 2 GHz		Weinschel Model 1541
2 - 4 GHz		Weinschel Model 1542
4 - 8 GHz		Weinschel Model 1543
8 - 12.4 GHz		Weinschel Model 1544
12.4 - 18 GHz		
Adjustable Length of Coaxial Line	12 inch travel	
Short Circuit		
Spectrum Analyzer		HP MODEL 8555A
Waveform Generator	±10 Volt, less than 1 microsecond rise time 10 to 1000 Hz	Exact Electronics 100
Ohmmeter	DC continuity	Simpson 261

TABLE 5-2. REQUIRED TEST EQUIPMENT FOR CALIBRATION PROCEDURES		
Title	**Requirements**	**Suggested Manufacturer and Model No.**
Precision DC Voltmeter	±0.1% accuracy, 400 K minimum resistance 1 millivolt sensitivity	Fluke 891A

Rear Panel	
SWEEP RESPONSE TIME	AUTO
RF MARKERS	ON
RF Unit	
RF	ON
If the RF Unit has Option 1 (internal leveling) set:	
LEVELER MODE	INT (depress)
RF LEVEL	Adjust fully clockwise then ccw unit leveling is obtained across the entire band.
If the RF Unit does not have Option 1 set:	
LEVELER MODE	OFF (depress)
RF LEVEL	Fully cw

c. Set the M1 and M2 indicators at the frequencies to be checked and adjust the MARKER AMPLITUDE as desired.

d. Tune the frequency meter to make its dip coincident with each marker dip.

e. Observe that the frequency indicator and the frequency meter indications fall within frequency accuracy limits of the RF Unit specifications.

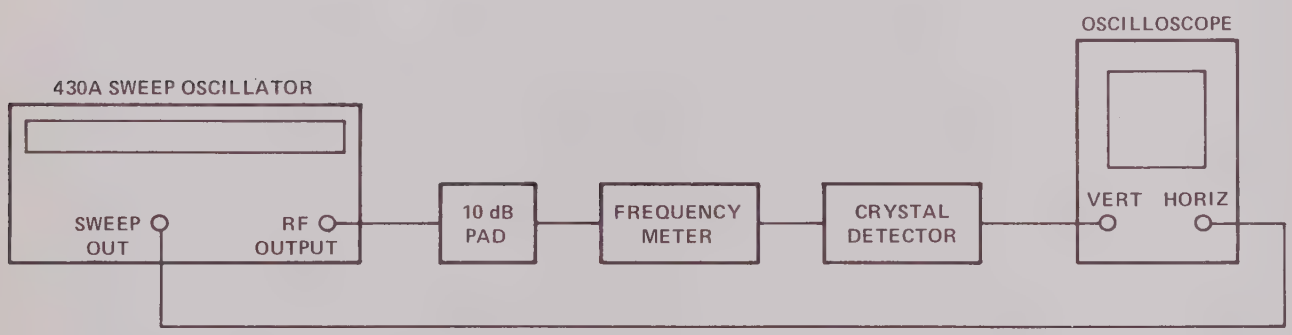


Figure 5-1. Frequency Accuracy Measurement Test Setup.

5.3.2 Spurious Signals

a. Connect the RF OUTPUT to the spectrum analyzer input. A 10 dB attenuator pad should be used to avoid burn-out of the spectrum analyzer input.

b. Set the SWEEP OSCILLATOR controls as follows:

M1	Midband (or any specific frequency to be investigated)
SWEEP FUNCTION	CW M1

1 kHz ⊓⊔	Off (down)
RF LEVEL	Fully clockwise

c. Observe the amplitude at the desired RF frequency, and at any spurious and harmonic frequency of interest. Follow the manufacturer's directions to distinguish spurious responses of the analyzer from those of the SWEEP OSCILLATOR

d. The unwanted responses should conform with Table 1-1 of this instruction manual.

5.3.3 Frequency Stability

Stability tests should be conducted in a temperature stable location free from drafts. Equipment warm-up of at least 15 minutes should be completed prior to measurements.

5.3.3.1 △F vs. 10 dB Change in RF Level

a. Connect the equipment per Figure 5-2. A high resolution frequency meter may be substituted for the spectrum analyzer.

b. Set Model 430A controls as follows:

M1	Midband (or any specific frequency to be investigated)
SWEEP FUNCTION	CW M1
1 kHz ⊓⊔	Off (down)
RF LEVEL	Fully clockwise
LEVELER MODE	INT or OFF

c. Observe the power meter reading in dB, and the RF frequency indication. Reduce the power by 10 dB via the RF LEVEL control.

d. Note the change in frequency indication. It should not exceed the specification of the unit as given in Table 1-1.

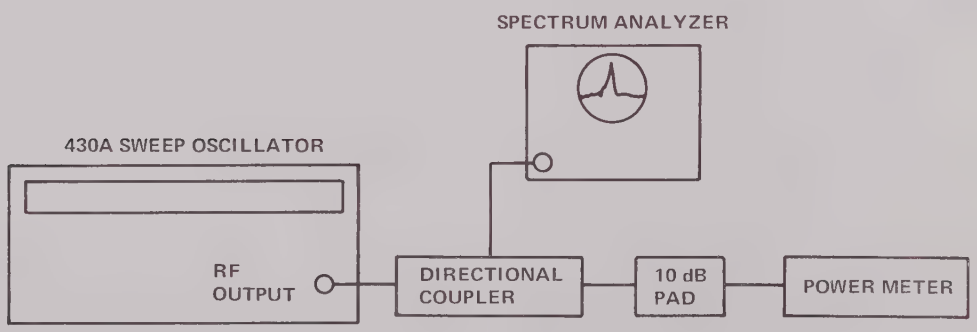


Figure 5-2. △F vs. 10 dB Change in RF Level Test Set-Up.

5.3.3.2 △F vs. 3:1 Load VSWR

a. Connect the equipment as shown in Figure 5-3.

NOTE

The combined insertion loss of the coupler and pad in the *main* line is to be 3 dB. Thus a 3 dB coupler and no pad or a 10 dB coupler and a 2½ dB pad are suitable combinations.

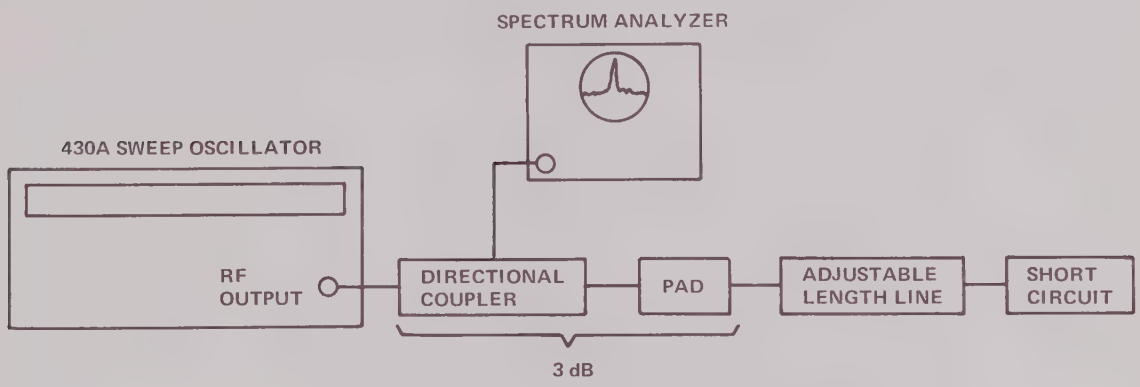


Figure 5-3. △F vs. 3:1 Load VSWR Test Set-Up.

b. Set the SWEEP OSCILLATOR controls as described in section 5.3.3.1.

c. Observe the peak-to-peak change in frequency indication as the adjustable length line is varied over at least a ½ wavelength. Divide by two to get peak △f.

d. The maximum allowable results should be within the specification as indicated in table 1-1.

5.3.3.3 △F vs. ±10% Line Voltage-Change

a. Connect equipment as shown in Figure 5-4.

b. Set Model 430A controls per Paragraph 5.3.3.1.

c. Adjust the AC line input over the range 105 to 125 volts RMS (or 210 to 250 if applicable). Note the peak-to-peak change in frequency indication. Divide by two.

d. The maximum allowable result is given in Table 1-1.

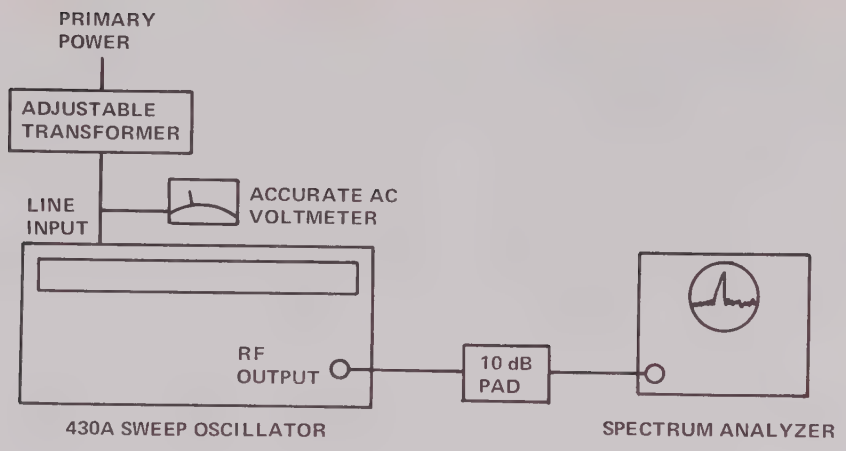


Figure 5-4. △F vs. ±10% Line Change Test Set-Up.

5.3.3.4 Frequency Modulation

a. Connect equipment as shown in Figure 5-5.

b. Set Model 430A controls as follows:

SWEEP FUNCTION	SYM M1
SWEEP TIME	MAN
SYMMETRICAL SWEEP WIDTH	FULLY CCW
M1	CENTER OF RANGE

c. Set the audio oscillator output for approx. 50 millivolts peak-to-peak.

d. Observe demodulated FM on oscilloscope. Measure the demodulated FM to be continuous from DC to the specific FM input frequency rate in Table 1-1.

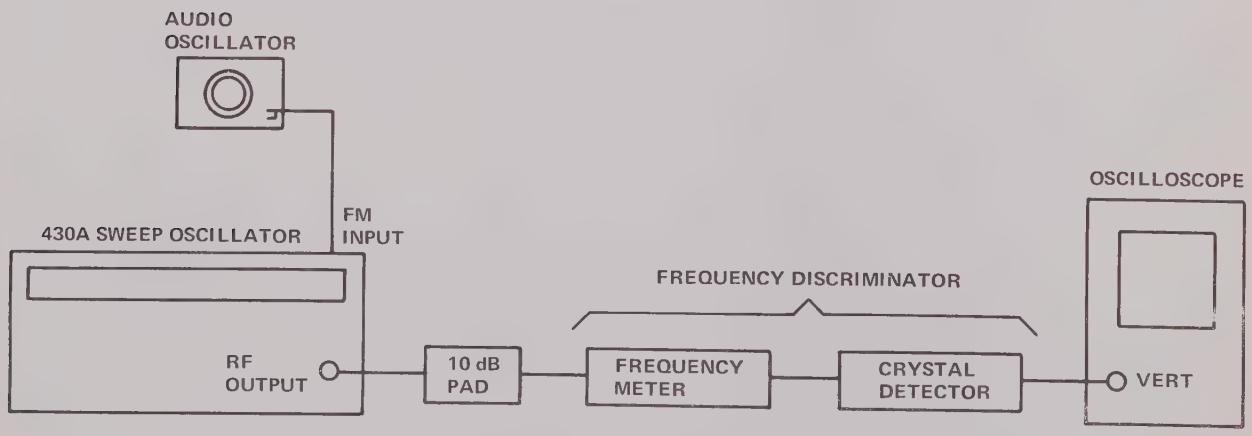


Figure 5-5. Frequency Modulation Test Set-Up.

5.3.4 Power Output (Unleveled)

a. Connect the power meter to the RF OUTPUT connector through a 10 dB pad. Do not use intervening cabling.

b. Set Model 430A controls as follows:

SWEEP FUNCTION	CW M1
1 kHz ⊓⊔	Off (down)
RF LEVEL	Fully cw
LEVELER MODE	OFF

c. Adjust the M1 control across the band and note the minimum output power level indicated on the power meter.

NOTE

Power meter and pad calibration factors must be taken into account when checking the power output level.

d. The minimum power indication should be equal to or higher than the minimum power output level (mW) as specified in the RF Unit specifications.

5.3.5 Power Variation (Leveled)

5.3.5.1 Internal Leveling

a. Connect a power meter to the RF OUTPUT connector through a 10 dB pad. Do not use intervening cabling.

b. Set Model 430A controls as follows:

MARKER AMPLITUDE	Fully ccw
SWEEP FUNCTION	F1 - F2
SWEEP TIME	MAN
F1	Low end of band
F2	High end of band
1 kHz ⊓⊔	Off (down)
LEVELER MODE	INT

c. Simultaneously adjust the RF LEVEL control ccw just enough to keep the unleveled indicator extinguished while rotating the SWEEP TIME (SEC) VARIABLE control through its entire range and note maximum and minimum power levels (dB) as indicated on the power meter.

d. The total power variation observed in step c should be less than the total variation specified for the RF Unit. The pad calibration value must be taken into account.

5.3.5.2 External Leveling

a. Connect equipment as shown in Figure 5-6.

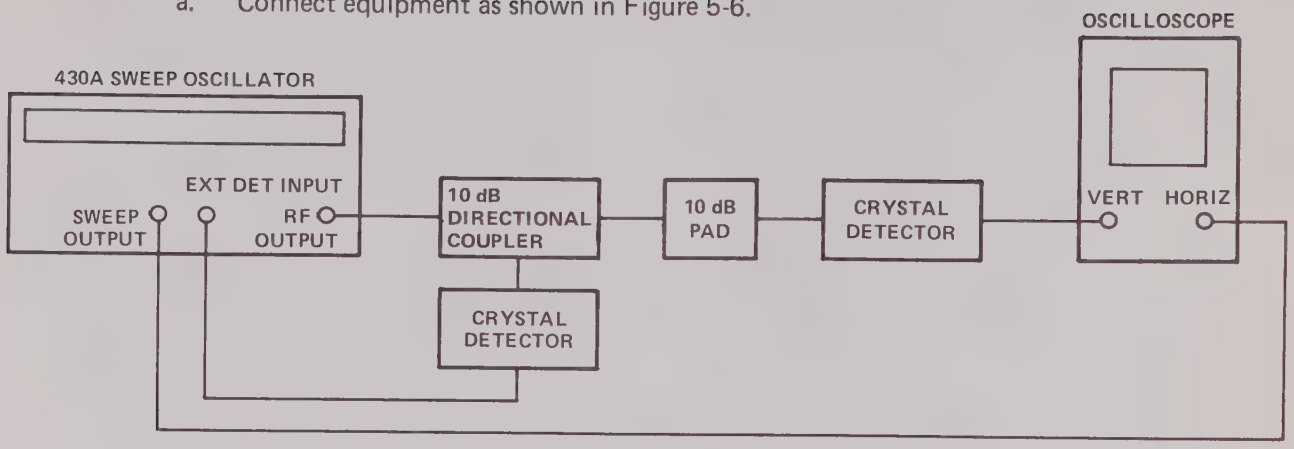


Figure 5-6. External Leveling Measurement Test Setup.

b. Set Model 430A controls as follows:

TRIGGER	LINE
SWEEP FUNCTION	F1 - F2
SWEEP TIME (SEC)	.01
F1	Low end of band
F2	High end of band
1 kHz ⊓⊔	Off (down)
SWEEP RESPONSE TIME	AUTO
LEVELER MODE	EXT XTAL*

c. Adjust the RF LEVEL control over its range and then rotate it ccw just enough to obtain leveling across the entire band making sure that the UNLEVELED indicator remains extinguished.

d. Replace the oscilloscope and crystal detector with an RF Power Meter as shown in Figure 5-7.

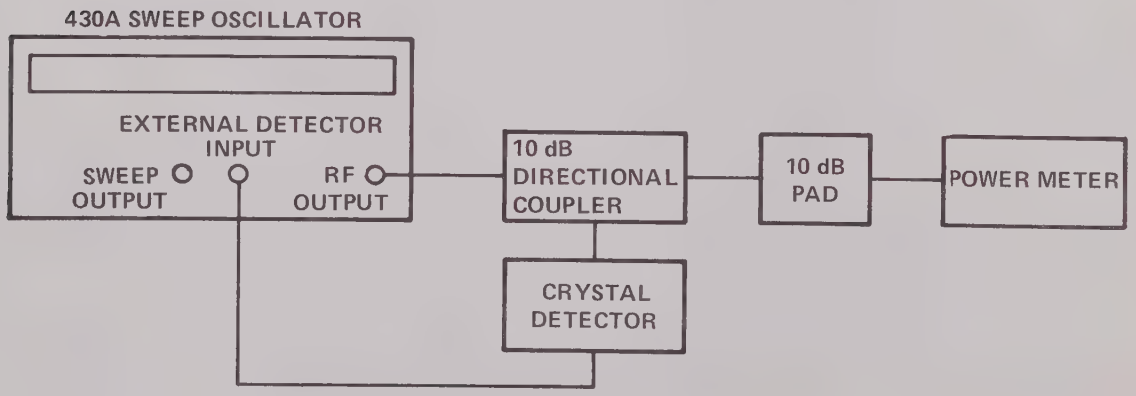


Figure 5-7. External Leveling Measurement Test Setup (2).

*XTAL/PWR MTR slide switch is located on top left hand side of RF Unit, near the front panel.

e. Set the SWEEP TIME control to MAN.

f. Rotate the VARIABLE SWEEP TIME control through its entire range and note the maximum and minimum power meter indications (dB).

g. The total power variation observed in step f should be less than the total variation specified for the RF Unit. The effect of the external crystal detector in addition to the 10 dB pad and external directional coupler variation must be taken into account.

5.3.5.3 Power Meter Leveling

a. Connect equipment as shown in Figure 5-2 with the following exceptions: substitute a power meter (HP Model 432A recommended) for the crystal detector and connect the DC output (recorder output) to the EXT DET INPUT on the Model 430A.

b. Set the Model 430A controls as follows:

MARKER AMPLITUDE	Fully ccw
SWEEP FUNCTION	F1 - F2
SWEEP TIME	MAN
F1	Low end of band
F2	High end of band
1 kHz ⊓⊔	Off (down)
LEVELER MODE	EXT with XTAL/PWR
	MTR slide switch set to PWR
	MTR

NOTE

Because the thermal response of the power meter is relatively slow the leveling loop bandwidth in the power meter leveling mode will be considerably less than the bandwidth in the XTAL mode. Therefore, it is necessary to sweep slowly (<) SWEEP/SEC in order to not exceed the bandwidth of the leveling loop.

c. Adjust the RF LEVEL control over its range and then rotate it ccw just enough to obtain leveling across the entire band making sure that the UNLEVELED indicator remains extinguished. The front panel GAIN adjust is functional only in the POWER METER mode, since the gain is automatically adjusted when in the XTAL mode, and may have to be adjusted accordingly for the particular power meter being used.

d. Rotate the VARIABLE SWEEP TIME control through its entire range and note the maximum and minimum power meter indications (dB).

e. Maximum power variation should be less than ± 0.1 dB.

5.3.6 Internal Square Wave

5.3.6.1 Unleveled

a. Connect equipment as shown in Figure 5-1 except that the frequency meter may be omitted and the 10 dB pad is connected directly to the crystal detector. Also, remove the cable between the SWEEP OUTPUT on the Model 430A and the horizontal input on the oscilloscope.

NOTE

The output of the crystal detector (connected to the oscilloscope) should be shunted by a resistor of approximately 600 ohms to reduce the time constant of the crystal detector.

b. Set the Model 430A controls as follows:

1 kHz ⊓⊔	ON
RF LEVEL	Fully ccw
LEVELER MODE	OFF

c. Using the oscilloscope time base, measure square wave rise time, fall time and period. Both rise and fall times should be 10 microseconds maximum. The period should be adjustable from less than 950 to more than 1050 microseconds.

5.3.6.2 Leveled

a. If the RF Unit has Option 1, use the same equipment setup as used in 5.3.6.1 and set the Model 430A controls as follows:

LEVELER MODE	INT
1 kHz ⊓⊔	ON
RF LEVEL	Rotate ccw until UNLEVELED indicator just goes out.

b. If the RF Unit does not have Option 1, set the controls as described in step (a) except that the LEVELER MODE must be set to XTAL.

c. Connect equipment as shown in Figure 5-6.

d. Using the oscilloscope time base, measure both rise and fall time and symmetry. Rise and fall time should each be 10 microseconds maximum; symmetry within 60:40

5.3.7 External AM

a. Connect equipment as shown in Figure 5-6.

b. Set Model 430A controls as follows:

1 kHz ⊓⊔	Off (down)
RF LEVEL	Mid range (approximate)
LEVELER MODE	OFF

c. Connect the output from a square wave generator to the rear panel AM Input. Adjust amplitude so that a further increase does not increase the RF amplitude. A positive voltage increases the output power if the RF LEVEL control is not fully counterclockwise while a negative voltage decreases the output power.

d. Rise and fall time should not exceed 2.3 microseconds; maximum amplitude into the AM Input connector should not exceed either +10 or −10 volts.

e. Set Model 430A controls as follows:

LEVELER MODE	INT
1 kHz ⊓⊔	Off (down)
RF LEVEL	Fully ccw

f. Repeat step c and check that rise and fall time does not exceed 3 microseconds.

5.3.8 Symmetrical Sweep Width Accuracy

a. Connect equipment as shown in Figure 5-1.

b. Set Model 430A controls as follows:

TRIGGER	LINE
SWEEP FUNCTION	SYM M1
SWEEP TIME (SEC)	.1
M1	Center of band
RF LEVEL	Fully cw
LEVELER MODE	OFF
SWEEP RESPONSE TIME	AUTO

c. At each setting of the SYMMETRICAL SWEEP WIDTH control to be checked (depending on RF Unit) tune the frequency meter to both the high and the low end of the frequency range being swept and note the two different frequency readings.

d. The difference between the two frequency meter readings and the corresponding frequency limits of the calibrated settings of the SYMMETRICAL SWEEP WIDTH control should be within ±3% for YIG tuned RF Units and ±10% of sweep width ±0.25% of maximum frequency for Varactor tuned RF Units.

5.3.9 Residual FM

a. Connect equipment as shown in Figure 5-1.

b. Set Model 430A controls as specified in Paragraph 5.3.8, step b, except for the RF LEVEL control which is rotated fully clockwise.

c. Calibrate the frequency meter as a function discriminator as follows: Tune the frequency meter so that its dip is centered in the oscilloscope display as shown in Figure 5-8. Place a straight edge on the display and measure the maximum slope of the frequency meter dip. Divide the vertical measurement to obtain the discriminator constant in millivolts/kHz.

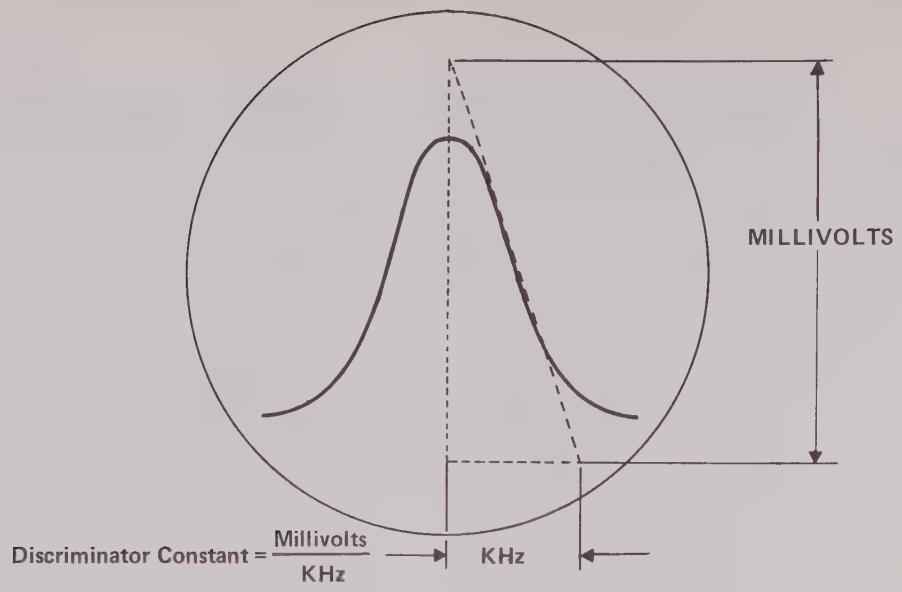


Figure 5-8. Slope Discriminator Display.

d. Set SWEEP FUNCTION switch to SYM M1.

e. Set SWEEP TIME (SEC) switch to MAN and rotate the VARIABLE (vernier) control fully counterclockwise.

f. Rotate SYMMETRICAL SWEEP WIDTH control (on RF Unit) fully counterclockwise for narrowest sweep width.

g. Increase the oscilloscope vertical sensitivity and tune the frequency meter for maximum peak-to-peak vertical amplitude. The oscilloscope time base should be used. Record the peak-to-peak amplitude.

h. Divide the peak-to-peak amplitude figure by the discriminator constant to obtain kHz peak-to-peak. Then divide by 2 to obtain peak residual FM. This should not exceed the specification for the RF Unit being used.

NOTE

To ensure that the auto bandwidth circuitry is functioning properly, place the SWEEP RESPONSE TIME slide switch (on rear panel) to FAST. The residual FM should increase considerably. Then set the switch back to AUTO. Within a few seconds, the residual FM should decrease to its minimum value indicating that the bandwidth has been reduced.

5.3.10 Proportional Sweep Amplitude

a. Connect the PROPORTIONAL OUTPUT to the oscilloscope vertical input.

b. Set Model 430A controls as follows:

b. Set Model 430A controls as follows:

TRIGGER	LINE
SWEEP FUNCTION	F1 - F2
SWEEP TIME (SEC)	0.1
F1	Lower limit
F2	Upper limit
PROPORTIONAL	10V/BAND

c. The PROPORTIONAL OUTPUT voltage should start at +0.25 (±0.25) volts and finish at +9.75 (±0.25) volts.

d. Set the rear panel PROPORTIONAL switch to 40 V/OCTAVE.

e. The PROPORTIONAL OUTPUT voltage should now start at +1 (±1) volt and finish at +40 (±3) volts for RF Units covering a full octave. The 434A and the 435A RF Units do not cover a full octave and therefore the end frequency voltage will be proportionally less.

5.4 CALIBRATION PROCEDURE

In the following paragraphs, reference is made to Test Points. As an aid in locating these points use Figures 5-9A through 5-9E. These figures provide maps of all test points in the RF Unit.

5.4.1 Bias Supply

a. Connect voltmeter positive lead to TP3 and negative lead to TP2.

b. Turn on AC power.

c. Adjust R18 (for YIG tuned RF units or R15 for varactor tuned RF units) to obtain the bias voltage reading on the voltmeter equal to the value specified on the RF Source.

d. To check short circuit current limiting, place an ammeter momentarily across test points TP3 and TP2 for YIG units or TP5 and TP6 for varactor units on Assembly A2 and check that current reading is within limits shown in Table 5-3.

e. Connect an oscilloscope with hot lead to TP3 (YIG) or TP6 (varactor) and ground lead to TP2 (YIG) or TP5 (varactor) for RF Units having positive regulators. For units having negative regulators, connect the hot lead to TP2 (YIG) or TP5 (varactor) and the ground lead to TP3 (YIG) or TP6 (varactor).

f. Turn the unit ON and OFF by pushing the front panel PUSH ON button several times and observe that there is no overshoot on the rise of bias supply voltage after turn on.

5.4.2 Crowbar

a. Disconnect bias supply wires on terminals M and N or H and J as indicated in Table 5-3 (RF source terminals shown in Figure 5-10).

b. With the setup used in Paragraph 5.4.1 increase the bias supply voltage by turning R18 cw, until the crowbar circuit fires, as evidenced by a low (0.5 to 1.5V) reading on the

voltmeter. The firing should occur 5-6% above the voltage specified on the RF source for the models 434A and 435A. On all other models, the firing voltage of the crowbar should be 1.5 to 2.0 volts above the specified RF source bias voltage. If adjustment of R18 cannot increase the output sufficiently, turn R18 fully ccw and place a jumper across R9. Now turn R18 cw until the desired level is reached.

Turn the RF ON/OFF switch on the front panel of the RF Unit to the OFF position immediately after the crowbar circuit fires.

If R18 (YIG) or R15 (varactor) is turned a few turns ccw, when the RF ON/OFF switch is set to the ON position, the bias voltage should be restored.

Table 5-3
Bias Supply Short Circuit Specification

RF Unit	Bias Supply Terminal on A3 Board +	—	Minimum Short Circuit Current	Maximum Short Circuit Current
431A (WE)	H	J	0.5 amps	1.0 amps
431A (OM)	M	N	0.8 amps	1.1 amps
432A (AV)	M	N	0.8 amps	1.1 amps
433A (AV)	L	N	0.8 amps	1.1 amps
433A (WJ)	H	J	0.5 amps	0.9 amps
434A (VA)	M	N	0.9 amps	1.2 amps
435A (VA)	M	N	0.9 amps	1.4 amps
442A (AV)	M	N	0.8 amps	1.1 amps
438A (WE)	H	J	0.5 amps	1.0 amps
438A (OM)	Pin 6 of RF Source See Figure 5-10	Pin 5 of RF Source	0.8 amps	1.1 amps

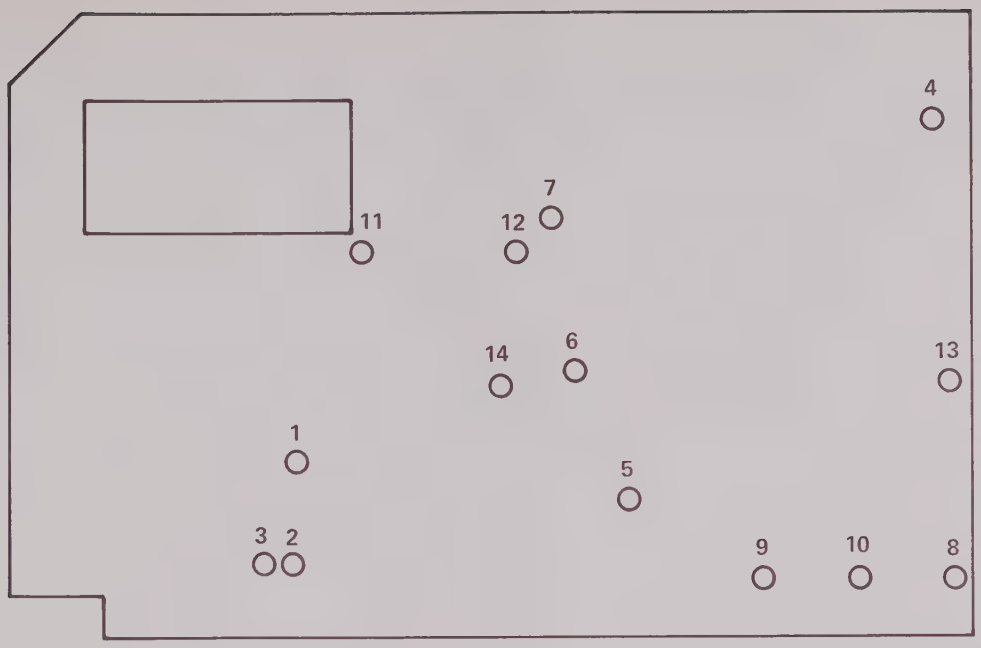


Figure 5-9A. Test Point Map of A2 Board (YIG Tuned RF Units Only)

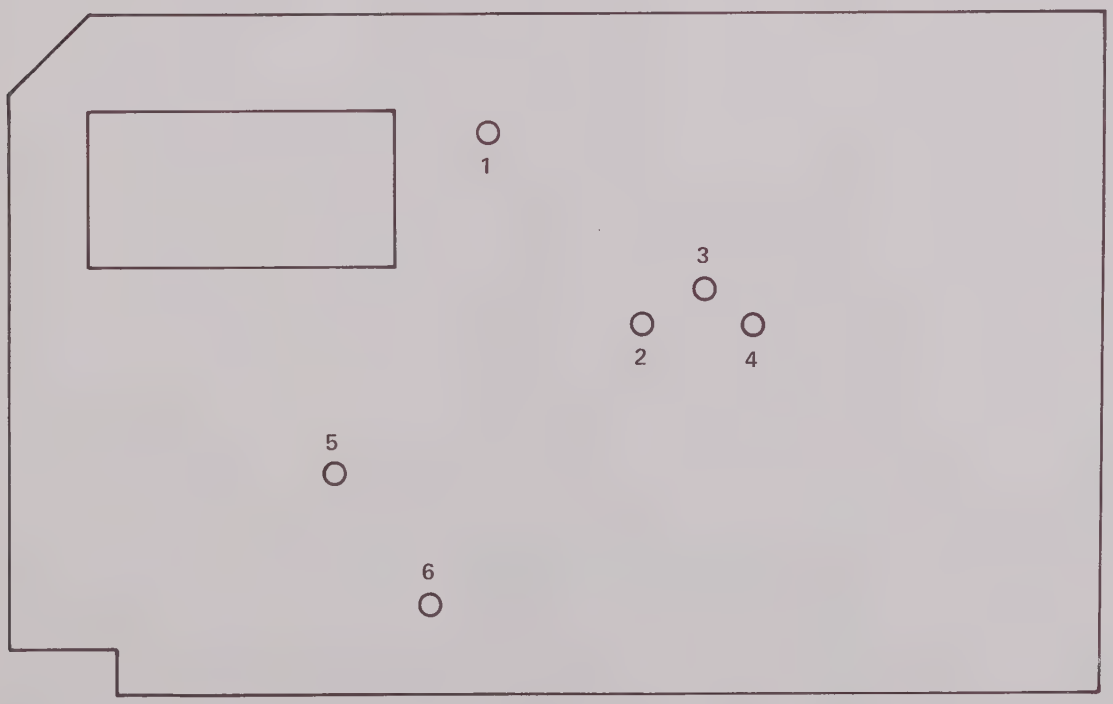


Figure 5-9B. Test Point Map of A2 Board (Varactor Tuned RF Units Only)

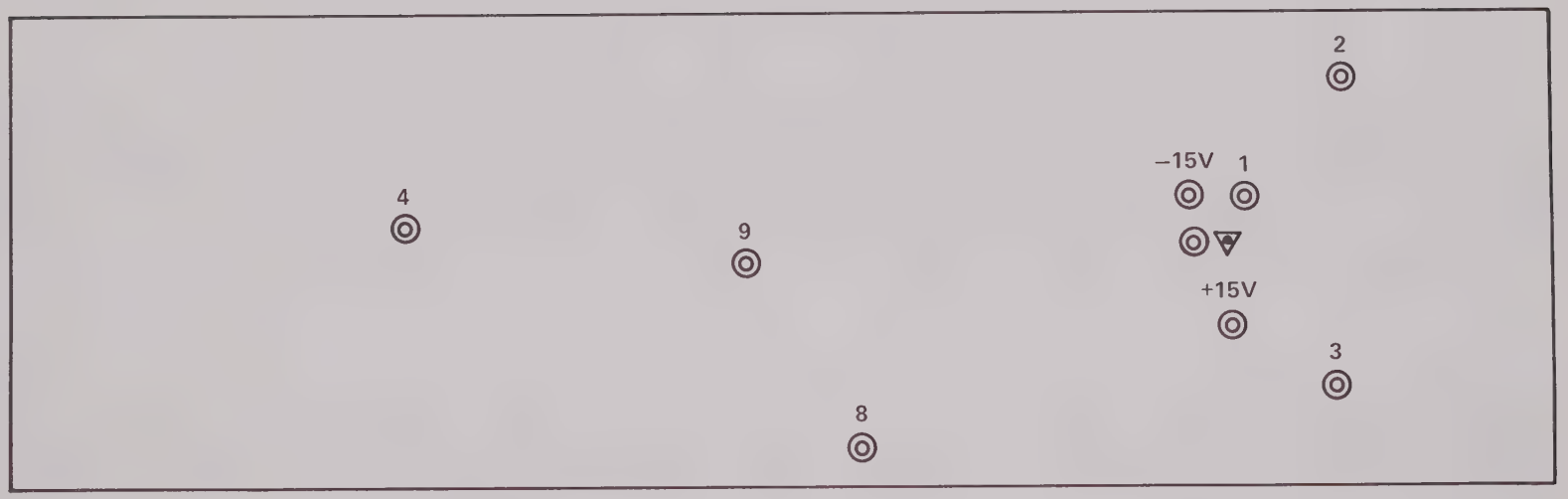


Figure 5-9C. Test Point Map of Leveler Board (A1)

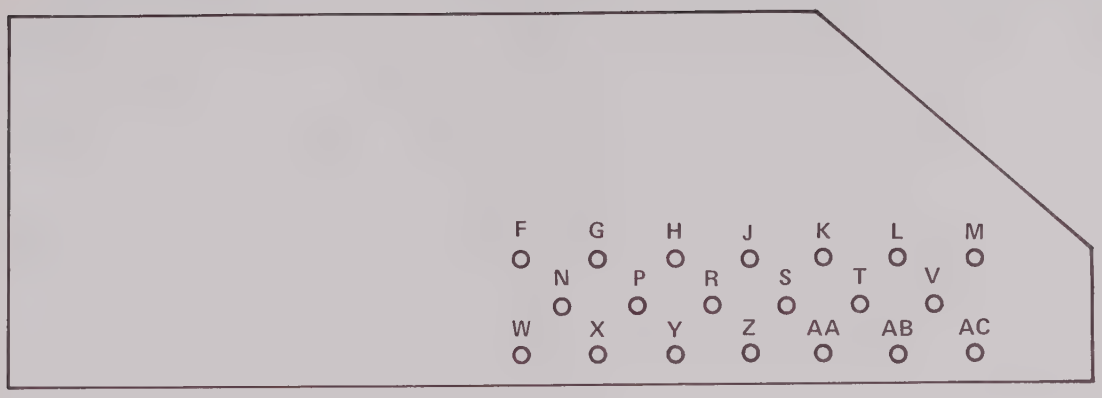


Figure 5-9D. Test Point Map of A3 Board

Figure 5-9E. Test Point Map of A5 Board (438A-1 Only)

c. If the crowbar firing does not occur at the correct voltage, R10 must be selected experimentally, using a DECADE BOX with short leads, for the correct value Note that a 0.01 μfd capacitor may be connected across any test leads to R10 to avoid pickup which causes erroneous firing of the crowbar.

d. Remove any jumper across R9 and restore R18 to its correct setting; the exact bias voltage specified on the RF source.

e. Turn the unit on and off by pushing the front panel push on button several times. Observe that the crowbar circuit does not fire after turn on when R18 is set to provide the proper bias voltage.

5.4.3 **YIG Tuning Supply (See Figure 5-10 to determine whether your RF Unit is YIG tuned or varactor tuned)**

a. Turn off AC Power.

b. Secondary Loop Calibration

1. Connect a jumper across the FM terminals J and H on the Assembly A3.

2. Connect an oscilloscope to TP10 and set the sweeper controls as follows:

SWEEP FUNCTION	F1 - F2
SWEEP TIME (SEC)	.01
VARIABLE	Fully cw

3. Place a jumper across CR42.

4. Observe the oscilloscope display shown in Figure 5-11.

5. Adjust R89 (SECONDARY LOOP OFFSET) so that amplitude B is equal to approximately 1/8 of the amplitude of A.

6. Remove jumper across CR42 and observe the display return to normal as shown in Figure 5-12.

7. Connect oscilloscope to TP9.

8. Observe oscilloscope display as shown in Figure 5-13 and adjust R108 (SECONDARY LOOP TRACKING) to obtain a horizontal line as illustrated by line 1 and having zero slope.

9. Remove jumpers connected across terminals J and H on Assembly A3.

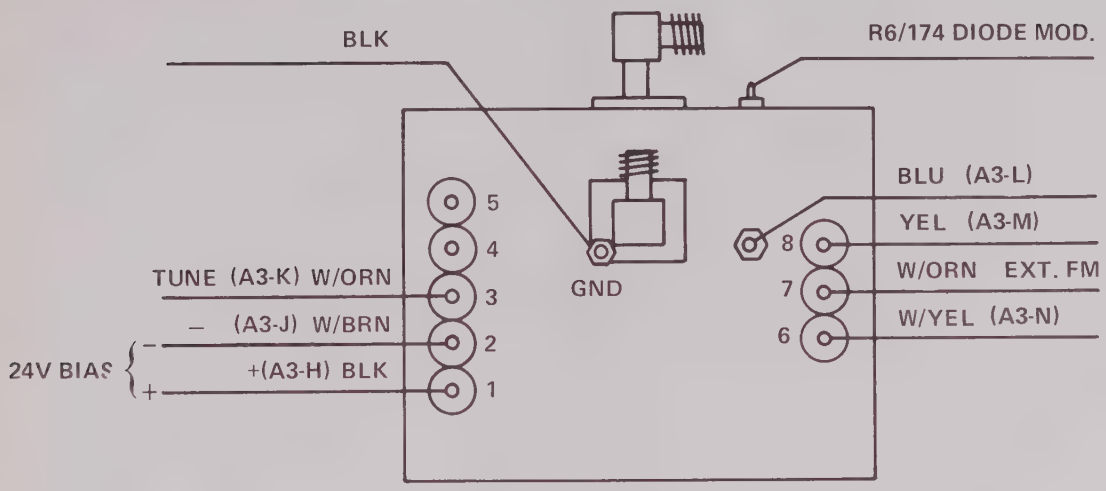
c. Primary Loop Calibration

1. Connect equipment as shown in Figure 5-14.

2. Set Model 430A Controls as follows:

	Front Panel
TRIGGER	Line
MARKER AMPLITUDE	Clockwise
SWEEP FUNCTION	F1 - F2

431A (WE) and 438A-1 (WE) VARACTOR TUNED SOURCE



433AH (WJ) VARACTOR TUNED SOURCE

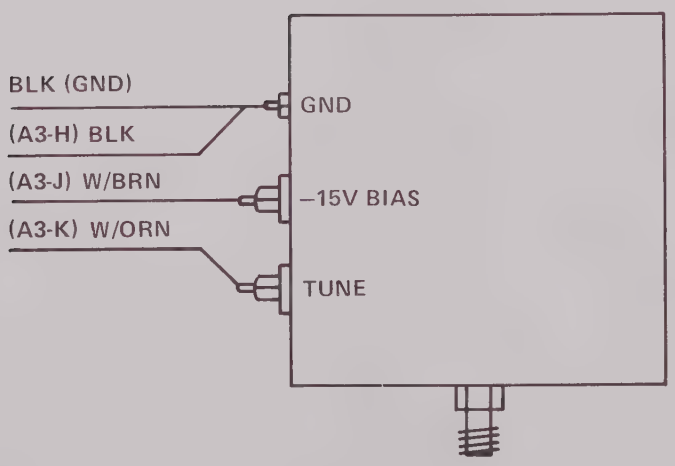
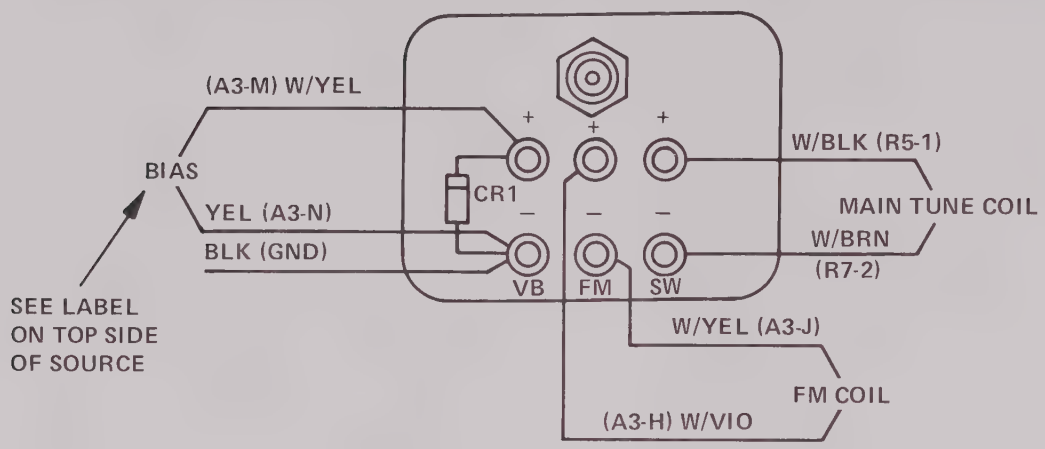


Figure 5-10. R.F. Source Terminal Location

434A & 435A (VARIAN) YIG TUNED SOURCE



433A (AVANTEK) YIG TUNED SOURCE

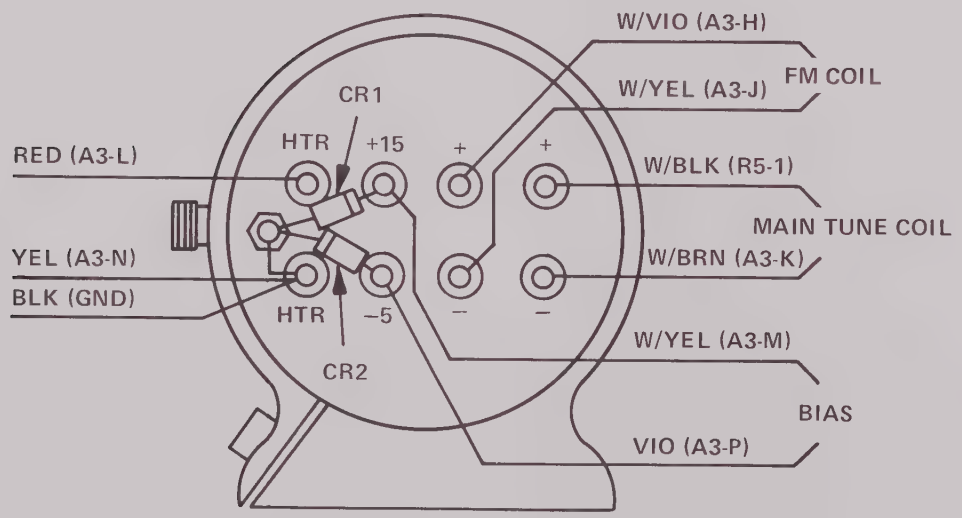
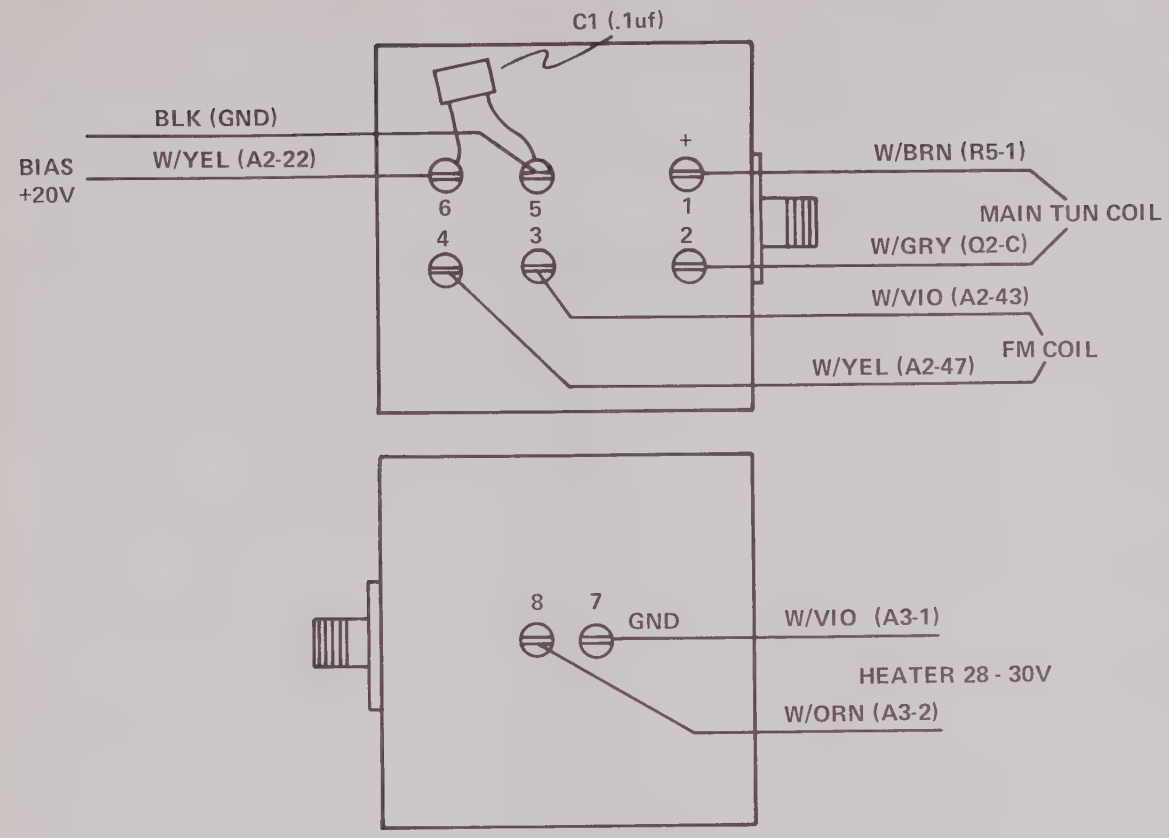


Figure 5-10 (Cont.). R.F. Source Terminal Location

438A-1 (OM) YIG TUNED SOURCE



432A and 442A (AVANTEK) YIG TUNED SOURCE

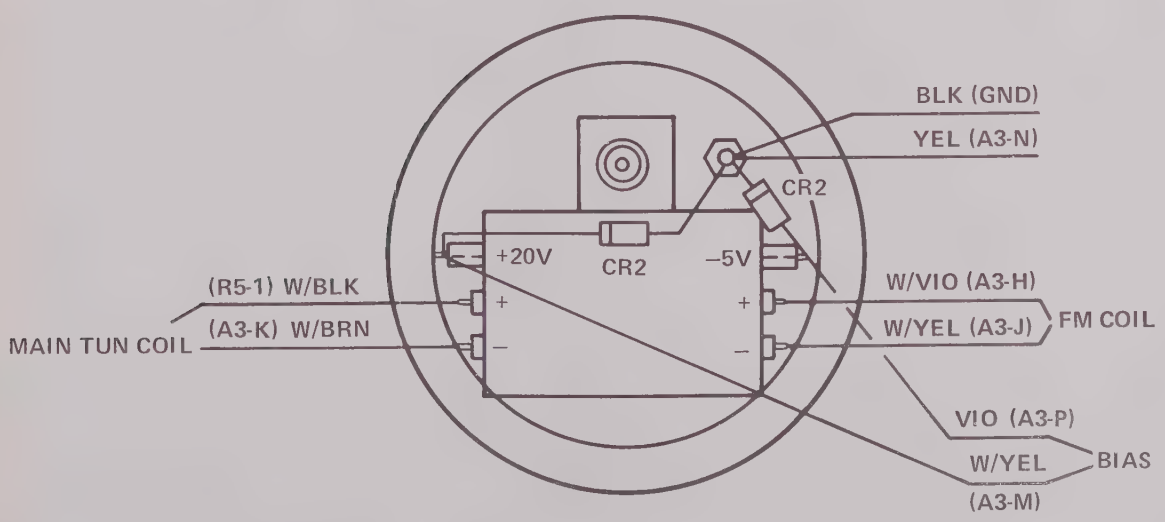


Figure 5-10 (Cont.). R.F. Source Terminal Location

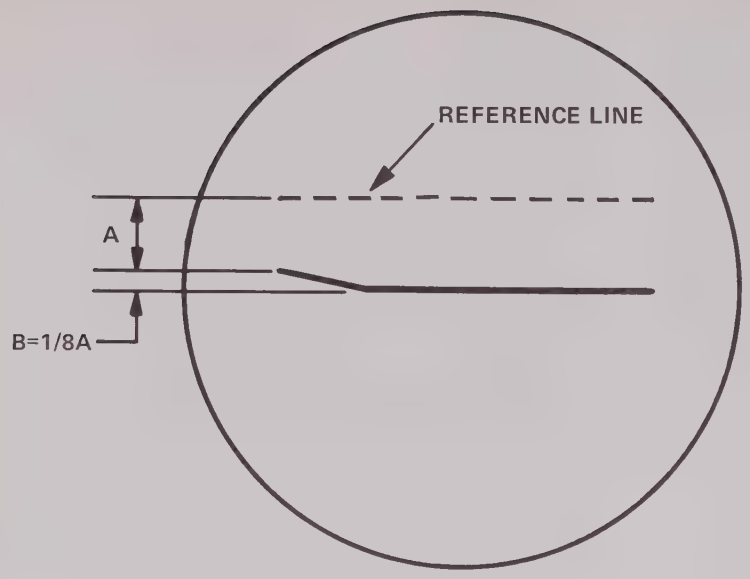


Figure 5-11. Oscilloscope Display, Offset

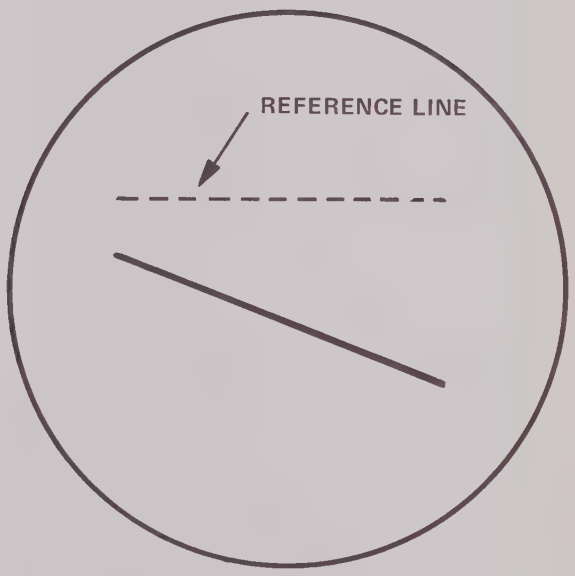


Figure 5-12. Oscilloscope Display, Ramp

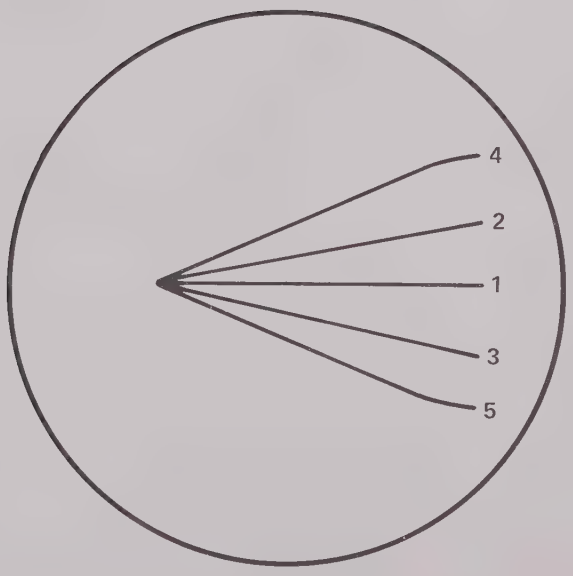


Figure 5-13. Oscilloscope Display, Tracking

SWEEP TIME (SEC)	.1
VARIABLE	Fully ccw
F1	Low Limit
F2	High Limit
1 kHz ⊓⊔	Off (down)
PUSH ON	Depress and Release
Rear Panel	
SWEEP RESPONSE TIME	Auto
RF MARKERS	On
RF Unit	
RF	On
If the RF Unit has Option 1 (internal leveling) set:	
LEVELER MODE	INT (Depress)
RF LEVEL	Adjust ccw until leveling is obtained across entire band.
If the RF Unit does not have Option 1, set:	
LEVELER MODE	OFF (Depress)
RF LEVEL	Fully ccw

3. Set the M1 and M2 indicators at the low end calibrated limit and the high end calibrated limit (i.e. 2.0 and 4.0 GHz) respectively.

4. Set the frequency meter to the low limit (i.e. 2.0 GHz).

5. Adjust R31 (PRIMARY LOOP OFFSET) to make the frequency meter dip coincide with the marker.

6. Set the frequency meter to the high end limit (i.e. 4.0 GHz).

7. Adjust R104 (PRIMARY LOOP TRACKING) to make the frequency meter dip coincide with the marker.

8. Since there is some interaction between controls R31 and R104, repeat steps 4 through 7 until no further adjustments are required.

9. Place a jumper across CR30 (Disables secondary loop) and verify that the frequency markers are still calibrated. If not, go back to Step b and repeat all steps.

d. YIG Lag Compensation

1. Connect equipment and set controls as indicated in step c. 2.

2. Place a jumper across CR29. (Disables high frequency clamp.)

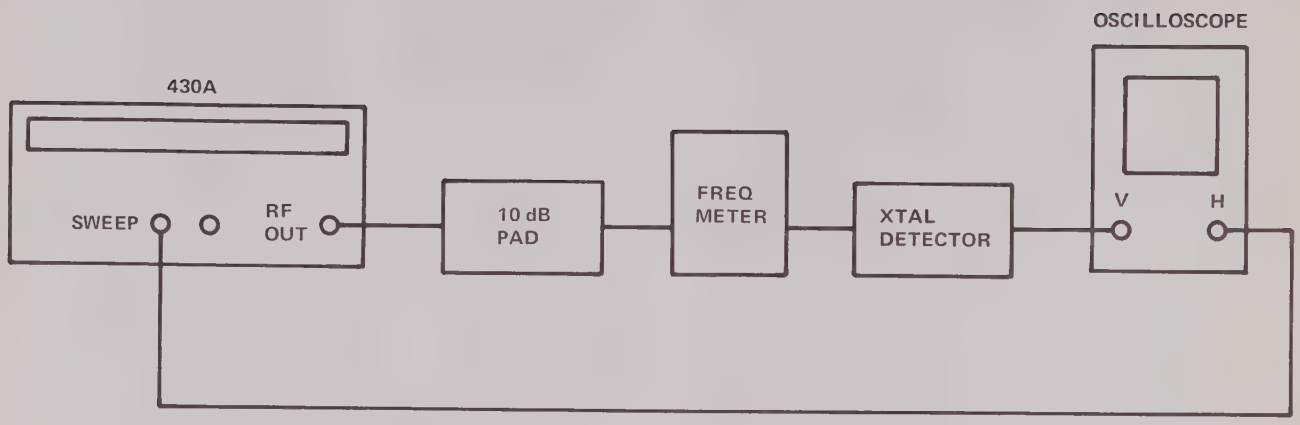


Figure 5-14. Primary Loop Calibration Test Set-Up

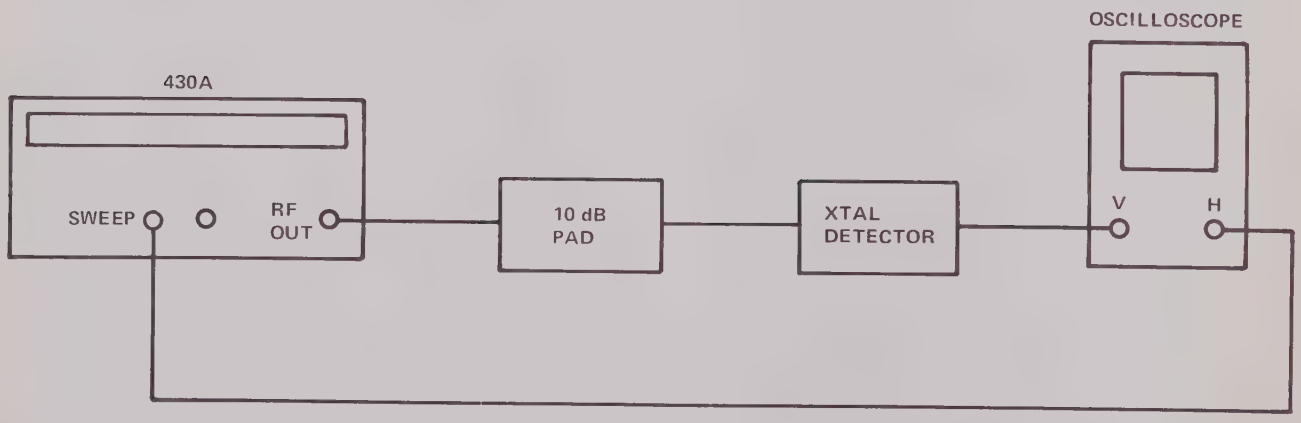


Figure 5-15. High Frequency Clamp Calibration Test Set-Up

3. Set the frequency meter dip to coincide with the high end frequency marker (i.e. 4 GHz).

4. Switch the SWEEP TIME (SEC) control to .01 and observe the shift in relative position between wavemeter dip and marker. Adjust R50 YIG COMPENSATION so that no relative shift is observed.

5. Remove jumper across CR29.

e. High Frequency Clamp

1. Connect equipment as shown in Figure 5-15.

2. Set the Model 430A controls as follows:

Front Panel

TRIGGER	LINE
MARKER AMPLITUDE	Clockwise
SWEEP FUNCTION	SYM M1
SWEEP TIME (SEC)	.1
VARIABLE	Fully cw
F1	Low Limit
F2	Max. cw
1 kHz ⊓⊔	Off (down)
PUSH ON	Depress and Release
M1	2/3 Full Scale
SYM SWEEP SWITCH	Switch fully cw
ON RF UNIT	VARIABLE fully cw

Rear Panel

SWEEP RESPONSE TIME	AUTO
RF MARKERS	ON

RF Unit

RF	ON
LEVELER MODE	OFF (Depress)
RF LEVEL	Fully cw

3. Adjust R87 so that F2 MARKER is partially removed from display.

5.4.4 Varactor Tuning Supply (Models 433AH and 433AP only)

a. Connect equipment as shown in Figure 5-14.

b. Set Model 430A controls as follows:

Front Panel

SWEEP FUNCTION	F1-F2
SWEEP TIME (SEC)	.1
SWEEP TIME (SEC) VARIABLE	Fully cw
TRIGGER	AUTO
F1	Low Limit
F2	High Limit
M1	4.0 GHz
M2	8.0 GHz
MARKER AMPLITUDE	As Desired
1 KHz	OFF (Down)
PUSH ON	Depress and Release

RF Unit

LEVELER MODE	INT (For Units with −1 option) OFF (For Standard Units)
RF ON-OFF	ON (Up)

Rear Panel

RF MARKER	ON
RF DURING RETRACE	OFF

c. With the M1 indicator set at exactly 4.0 GHz, tune the frequency meter until its frequency dip coincides with the M1 marker dip on the oscilloscope.

d. Prepare a graph of Frequency Error versus Frequency (Typical error curve shown in Figure 5-16), by plotting the difference between the frequency meter reading and the M1 indicator setting on the graph. Repeat this procedure at 100 MHz increments to obtain a complete frequency error plot

NOTE

Blank tear-out Frequency Error Graphs are provided for your convenience at the end of Section 5.

e. If the frequency error plot only slightly exceeds the ±1% frequency limits proceed to Paragraph 5.4.4.1, Minor Frequency Adjustment. If the plot drastically exceeds the limits proceed to Paragraph 5.4.4.2, Major Tuning Supply Maintenance.

5.4.4.1 Minor Frequency Adjustment

a. Turn off main power and remove the RF Unit from the Mainframe.

b. Remove the top cover of the RF Unit and lift up the Tuning and Bias Supply Assembly A2 PC board.

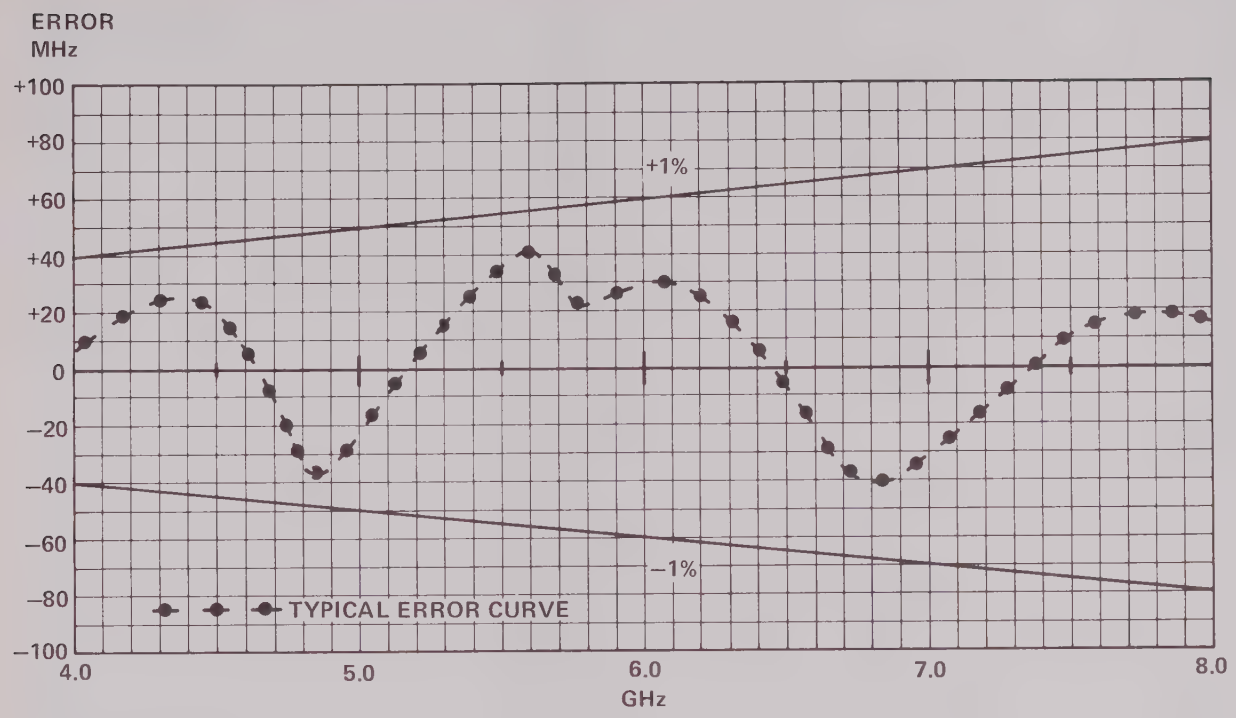


Figure 5-16. Typical Frequency Error Plot for 4 to 8 GHz Varactor Tuned RF Units

c. Using an extender cable, connect the RF Unit to the mainframe and insure that the Model 430A and RF Unit controls are set as specified in Paragraph 5.4.4, step b.

d. With the M1 indicator set at exactly 4.0 GHz, tune the frequency meter until its frequency dip coincides with the M1 marker dip on the oscilloscope.

e. An RF Unit slightly out-of-specification around 4.0 GHz, in most cases, can be brought within the ±1% limit by making a small adjustment to the OFFSET potentiometer, A2R84 (See Figure 7-6).

f. An RF Unit slightly out-of-specification between 4.3 and 4.6 GHz can usually be corrected by a small adjustment of the GAIN potentiometer, A2R78 (See Figure 7-6).

g. An RF Unit slightly out-of-specification between 4.7 and 5.3 GHz can usually be corrected by a small adjustment of the REVERSE SLOPE potentiometer, A2R46 (See Figure 7-6).

h. A slight out-of-specification condition above 5.3 GHz can usually be corrected by adjusting the appropriate BREAK POINT potentiometers, A2R52, R54 or A2R56 thru R62. Proceed with the following steps to determine which Break Point potentiometer should be adjusted.

    1. With the equipment still connected as shown in Figure 5-14, set the M1 indicator and the frequency meter to the out-of-specification frequency.

2. Using clip leads, connect a resistor of approximately 1K in parallel with each shaping resistor, starting with A2R37 and working toward A2R27 while observing the oscillosope display.

3. When the position of the frequency meter dip is affected, the corresponding BREAK POINT potentiometer should be adjusted slightly until the M1 marker dip coincides with the frequency meter dip.

i. Any adjustment made in steps e. through h. may affect the frequencies above the corrected one. Therefore, it may be necessary to repeat steps e. through h.

5.4.4.2 Major Tuning Supply Maintenance

CAUTION

Turn off main power while soldering components or wires on PC boards.

a. Set up equipment as shown in Figure 5-14. Turn off main power and remove the RF Unit from the mainframe.

b. Remove the top cover from the RF Unit and lift up the Tuning and Bias Supply Assembly A2 PC board.

c. Using an extender cable, connect the RF Unit to the mainframe and insure that the Model 430A and RF Unit controls are set as specified in Paragraph 5.4.4, step b.

d. Unsolder and lift one side of resistors A2R48 and A2R24 (See Figure 7-6). This removes the shaping network from the feedback circuit of the tuning supply.

e. Connect the oscilloscope vertical input to A2TP2.

f. Turn on the ac line power switches and observe that a linear negative ramp voltage starting at approximately −10 to −13 volts should be present on the oscilloscope. (See Waveform A, Figure 5-17). If this waveform is not present standard trouble-shooting procedures should be used. If waveform is present proceed to step g.

g. Using clip leads, momentarily connect a 10K resistor in parallel with A2R79. The slope of the ramp voltage should become more negative if the circuit is functioning properly (See Waveform B, Figure 5-17).

h. Resolder A2R24. The last ½ to 2/3 of the ramp voltage should now have a less negative slope as shown in Figure 5-17, Waveform C.

i. Momentarily parallel A2R26 with a 10K resistor. The ramp voltage, after the break point should become less negative or may become slightly positive as shown in Figure 5-17, waveform D.

j. Resolder A2R48 and make a frequency error plot as described in Paragraph 5.4.4, steps c., d. and e.

k. If the RF Unit cannot be brought within the ±1% frequency accuracy specification by the Minor Frequency Adjustment procedure (Paragraph 5.4.4.1), proceed with the following steps.

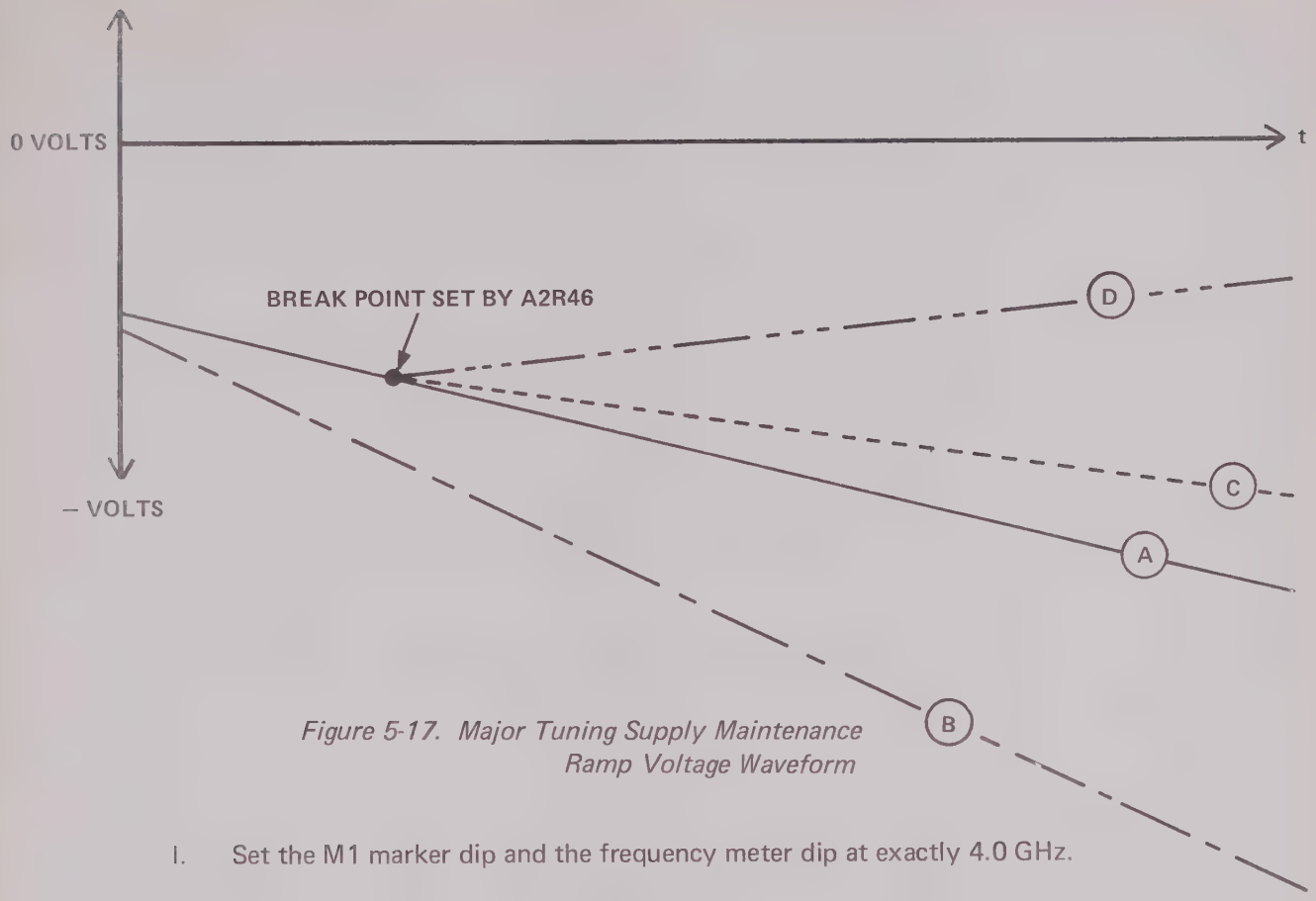


Figure 5-17. Major Tuning Supply Maintenance Ramp Voltage Waveform

l. Set the M1 marker dip and the frequency meter dip at exactly 4.0 GHz.

m. Turn AC power switches off and replace A2R82 with a resistance decade box set to the value of A2R82. Adjust potentiometer A2R84 (a 20-turn unit) to the center of its range.

n. Turn on the AC power and adjust the resistance decade box so that the M1 marker dip and the frequency meter dip are approximately coincident. The decade resistance box setting now indicates the proper value for the replacement A2R82. Adjust A2R84 until the M1 and frequency meter dips are in coincidence.

o. Move the M1 indicator to 4.1 GHz. Read the actual frequency with the frequency meter and plot the frequency error. Continue this procedure at 0.1 GHz increments until the frequency error exceeds the ±% limit. Then perform the following steps as appropriate.

1. If the out-of-specification condition exists between 4.3 and 4.6 GHz, replace A2R79 with a resistance decade box. Position potentiometer A2R78 (20-turn unit) to the center of its range and adjust the decade box until the M1 marker dip and the frequency meter dip are coincident. Potentiometer A2R78 and the resistance decade box may both have to be adjusted for the best overall accuracy between 4.3 and 4.6 GHz. Replace A2R79 with a resistor having the same value as indicated by the decade box setting.

2. If the out-of-specification condition exists between 4.7 and 5.3 GHz replace A2R24 with a resistance decade box. Position A2R46 (20 turn unit) to the center of its range. Set the M1 indicator and the frequency meter to 5.0 GHz. Adjust the decade box and potentiometer A2R46 as required to achieve

the desired frequency accuracy between 4.7 and 5.6 GHz. Replace A2R24 with a resistor having the same value as indicated by the decade box setting.

p. For out-of-specification frequencies above 5.3 GHz, the following alignment procedures should be used.

1. Locate the appropriate break point by using the method described in Paragraph 5.4.4.1 steps h. and i.

2. Replace the appropriate resistor with a resistance decade box. Adjust the BREAK POINT potentiometer (for that segment of the circuit) and the resistance decade box to achieve the desired frequency accuracy.

NOTE

Several resistance decade boxes may have to be used in place of resistors A2R27 thru A2R37 since there will usually be an interaction between adjacent circuits.

3. Repeat the above step until the total frequency range is aligned and all points fall within the ±% frequency accuracy specification.

5.4.5 Leveler

a. Set Model 430A controls as follows:

FRONT PANEL

TRIGGER	AUTO
SWEEP FUNCTION	F1-F2
SWEEP TIME	.01
VARIABLE	Fully cw
F1	Low end of scale
F2	High end of scale
1 KHz ⊓⊔	Off
M1	Center
M2	High end of scale

REAR PANEL

RF DURING RETRACE	Off
RETRACE	Off

RF UNIT

LEVELER MODE	Off
RF LEVEL	Fully cw

b. Set PWR/XTAL Switch (S2) located on Assembly A1 to XTAL position.

c. Connect oscilloscope to TP4.

d. Adjust R44 so that level observed on oscilloscope is between −5 and −10 millivolts.

e. Connect equipment as shown in Figure 5-18.

f. Depress INT button of LEVELER MODE to establish internal leveling.

g. Adjust RF LEVEL control so that the RF output is approximately 25% below the level at which the output is leveled across the entire band.

h. Set 1 KHz ⊓⊔ to ON position.

i. Observing the RF output displayed on the oscilloscope, adjust R16 for minimum overshoot consistent with fast rise time. This adjustment should result in a rise time within specifications and less than 10% overshoot.

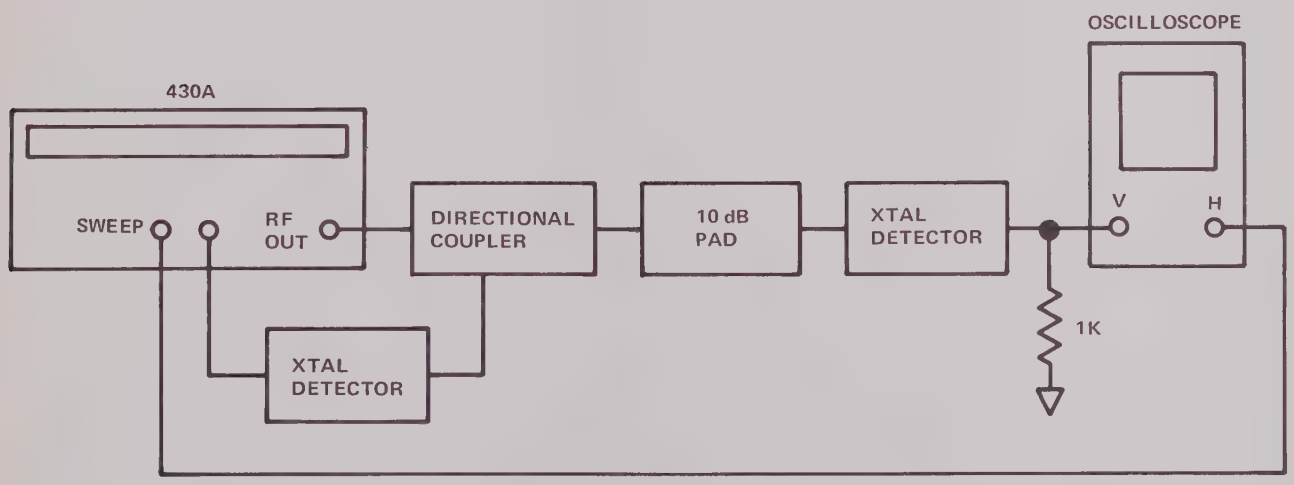
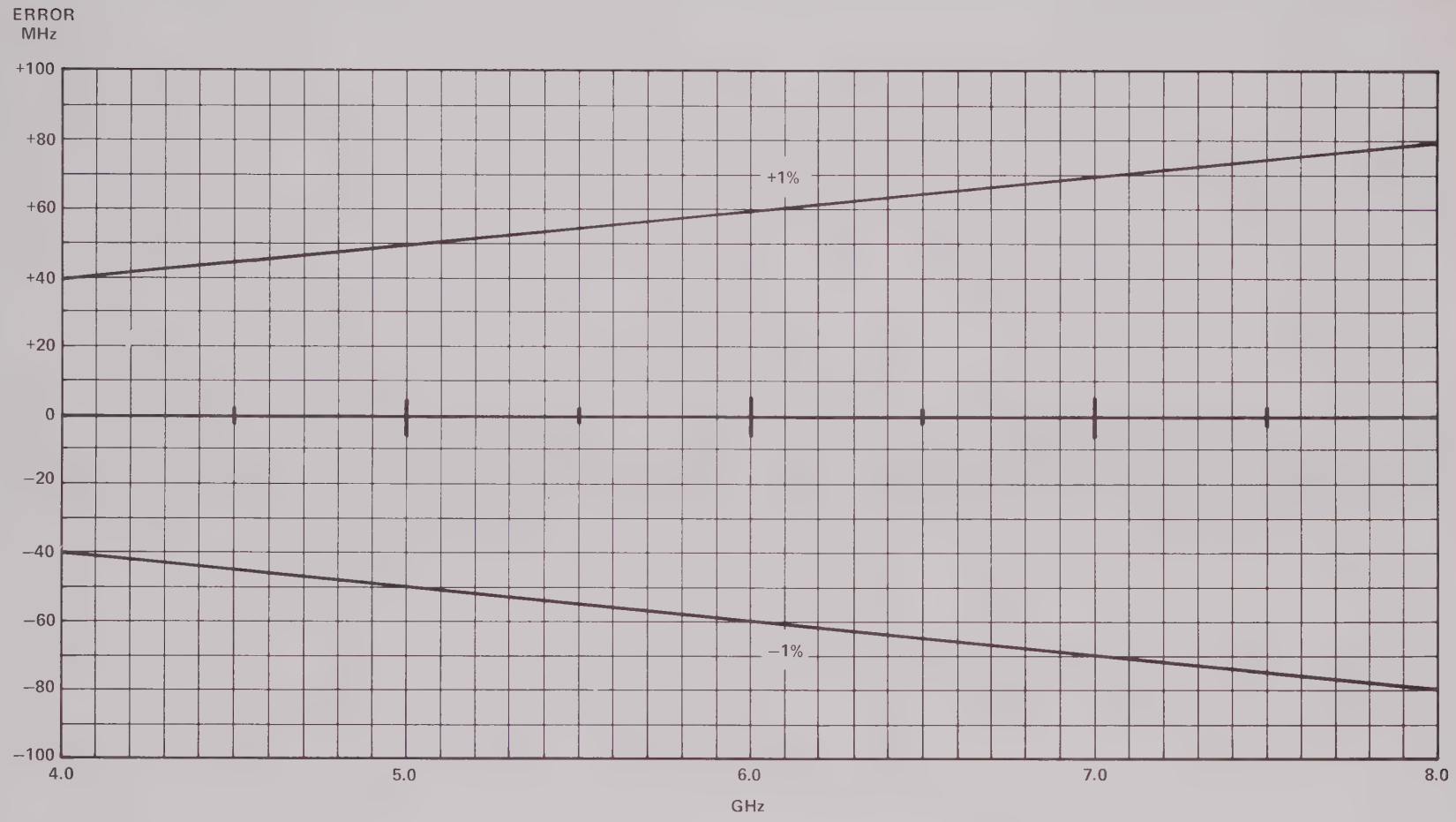
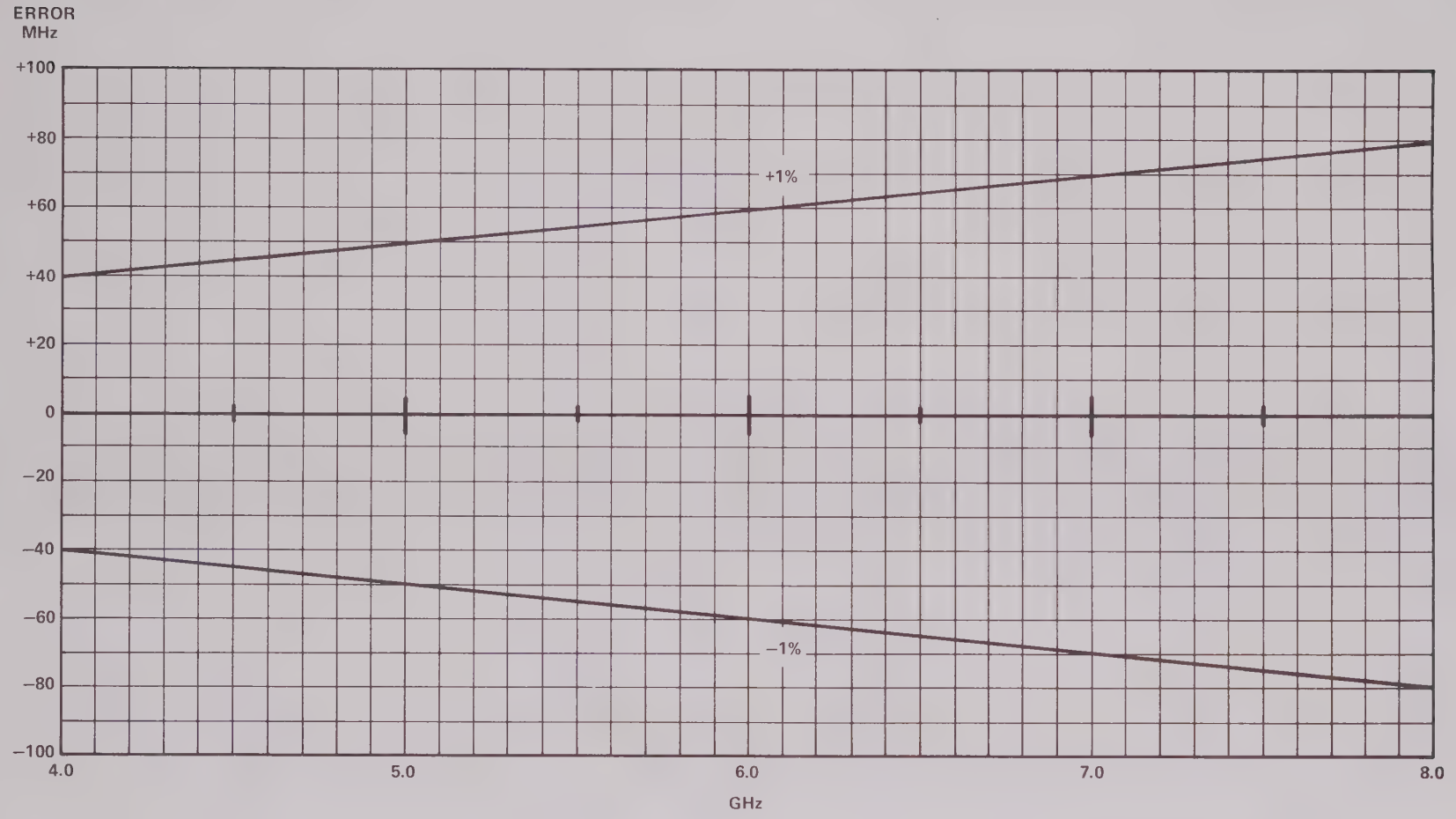


Figure 5-18. Leveling Calibration Test Set-Up



NOTE: This is a tear-out sheet provided for your convenience when preparing a Varactor Tuning Supply Frequency plot as described in Paragraph 5.4.4, steps c. and d.

FREQUENCY ERROR PLOT FOR 4 - 8 GHz VARACTOR TUNED RF UNIT



NOTE: This is a tear-out sheet provided for your convenience when preparing a Varactor Tuning Supply Frequency plot as described in Paragraph 5.4.4, steps c. and d.

FREQUENCY ERROR PLOT FOR 4 - 8 GHz VARACTOR TUNED RF UNIT

SECTION 6
REPLACEABLE PARTS

6.1 INTRODUCTION

This section provides information for procuring replaceable parts for the RF Unit. The parts listed include all parts subject to burnout, breakage or deterioration during normal operation of the equipment

6.2 REFERENCE DESIGNATIONS AND ABBREVIATIONS

See Table 6-1 for a complete explanation of reference designations and abbreviations.

6.3 ORDERING INFORMATION

The following information should be included when ordering replacement parts for the RF Units.

a. Weinschel Engineering Part Number and Description of Part.

b. The instruments Model Number and Serial Number.

c. If ordering a part not included in the replaceable parts list, include a complete description of the part, its function and its location within the equipment.

6.4 PARTS LIST AND CROSS REFERENCE TABLE

Table 6-2 is a model/assembly cross reference which lists the replaceable part table applicable to each model of RF Unit. This table provides the part number of each major assembly and the appropriate table which details all parts of that major assembly.

TABLE 6-1
ABBREVIATIONS AND REFERENCE DESIGNATIONS

All reference designations for electrical parts will be preceded by a prefix which will indicate the assembly in which it is contained. These prefixes will be identified as follows:

A1	—	LEVELER
A2	—	TUNING AND BIAS SUPPLIERS
A3	—	AUXILIARY REFERENCE SUPPLY
A4	—	SYMMETRICAL SWEEP OSCILLATOR
A5	—	SOLID STATE OSCILLATOR
A6	—	PIN DIODE SWITCH
A7	—	DIRECTIONAL COUPLER
A8	—	CRYSTAL DETECTOR
A9	—	ISOLATOR
A10	—	STEP ATTENUATOR
A11	—	HEAT EXCHANGER
*	—	BASIC CHASSIS ASSEMBLY

* Includes all parts within Basic Chassis Assembly not included in Assembly A1-A11.

NOTE

The above assembly designations are not applicable to the Model 438A RF Units.

ABBREVIATIONS

A	—	Amperes
AMPL	—	Amplifier
AM	—	Amplitude modulation
APPROX	—	Approximate
ASS'Y	—	Assembly
AUX	—	Auliliary
AVG	—	Average
BAL	—	Balance
BWO	—	Backward wave oscillator
C	—	Cathode
CAL	—	Calibrator
CCW	—	Counterclockwise
CW	—	Clockwise
dB	—	Decibel
dBm	—	Decibel (referred to 1 milliwatt in 600 ohms)
EXT	—	External
F	—	Farad
FIG	—	Figure
FIX	—	Fixed
FM	—	Frequency Modulate
A	—	Assembly
B	—	Motor
C	—	Capacitor
CR	—	Diode
DS	—	Lamp
F	—	Fuse
FWD	—	Forward
G	—	Giga = 10^{9}
GRD	—	Ground
H	—	Henry
Hz	—	Cycle per second
IDENT	—	Identification
IMP	—	Impulse
INT	—	Internal
K	—	Kilo = 10^{3}
LIN	—	Linear
M	—	Milli = 10^{-3}
MAX	—	Maximum
MEG	—	Meg = 10^{6}
MFG	—	Manufacturer
MIN	—	Minimum
N	—	Nano = 10^{-9}
NC	—	Normally closed
NEG	—	Negative
NO	—	Normally open
Ω	—	Ohm
O	—	Peak
J	—	Jack
K	—	Relay
L	—	Inductor
M	—	Meter
P	—	Plug
Q	—	Transistor
PC	—	Printed Circuit
PF	—	Pico farads = 10^{-12} farads
P/O	—	Part of
P-P	—	Peak to Peak
RECT	—	Rectifier
RES	—	Resistance or Resistor
RET	—	Return
REV	—	Reverse
RF	—	Radio Frequency
RMS	—	Square root of mean square
SEC	—	Second
SW	—	Switch
SYM	—	Symmetrical
TRIG	—	Trigger
TYP	—	Typical
U	—	Micro = 10^{-6}
V	—	Volt
VAR	—	Variable
W	—	Watts
R	—	Resistor
S	—	Switch
T	—	Transformer
TB	—	Terminal Board
V	—	Vacuum
X	—	Socket

MODEL [7]	FREQ RANGE	SCALE PART NUMBER	LEVELER A1 [4]		TUNING and BIAS SUPPLY A2		AUX REF SUPPLY A3		SYMMETRICAL SWEEP SWITCH A4		SOLID STATE OSCILLATOR A5		PIN DIODE SWITCH A6 [4]		DIRECTIONAL COUPLER A7 [2][4][5]		CRYSTAL DETECTOR A8 [2][4][5]		ISOLATOR A9		STEP ATTENUATOR A10 [5][8]		HEAT EXCHANGER A11		BASIC CHASSIS ASSEMBLY	
			TABLE NO.	PART NO.	TABLE NO.	PART NO.	TABLE NO.	PART NO	TABLE NO.	PART NO.	—	PART NO.	—	PART NO.	—	PART NO.	—	PART NO.	—	PART NO.	—	PART NO.	TABLE NO.	PART NO.	TABLE NO.	PART NO.
431A(WE)	1-2 GHz	B139-323	6-6	C139-168-2	6-8	C139-107-1	6-11	B139-111	6-12	B139-199	—	MP571-005	—	B1-72	—	C89-911	—	MP576-008	—	B1-74	—	C89-909-1	—	N/A	6-3	D139-189
431A(OM)	1-2 GHz	B139-323	6-6	C139-168-2	6-8	C139-107-1	6-11	B139-111	6-12	B139-199	—	B16-77	—	B1-72	—	C89-911	—	C89-928	—	N/A	—	C89-909-1	—	N/A		
432A(AV)	2-4 GHz	B139-270	6-6	C139-168-3	6-7-1	C139-109-1	6-11	B139-111	6-13	B139-200	—	B16-60	—	B1-72	—	C89-910-1	—	C89-928	—	B1-83 [3]	—	C89-909-2	—	N/A	6-4	D139-190
433A(AV)	4-8 GHz	B139-272	6-6	C139-168-3	6-7-2	C139-109-2	6-11	B139-111	6-13	B139-200	—	B16-56	—	B1-72	—	C89-929	—	C89-928	—	B1-87 [3]	—	C89-909-4	—	N/A	6-4	D139-190
433A(WJ)	4-8 GHz	B139-272	6-6	C139-168-3	6-9	C139-107-2	6-11	B139-111	6-13	B139-200	—	B16-57 [1]	—	B1-72	—	C89-929	—	C89-928	—	B1-87 [3]	—	C89-909-4	—	N/A	6-3	D139-189
434A(WJ)	8-12.4GHz	B139-273	6-6	C139-168-4	6-7-3	C139-109-3	6-11	B139-111	6-15	B139-201	—	B16-65 [1] B16-66	—	B1-72	—	B1-88	—	C89-928	—	B1-75	—	C89-909-5	6-18	B139-316-1	6-4	D139-190
434A(WAR)	8-12.4GHz	B139-273	6-6	C139-168-4	6-7-4	C139-109-4	6-11	B139-111	6-15	B139-201	—	B16-64 B16-69 [1]	—	B1-72	—	B1-88	—	C89-928	—	B1-75	—	C89-909-5	6-18	B139-316-1	6-4	D139-190
435A(WJ)	12.4-18GHz	B139-274	6-6	C139-168-4	6-7-5	C139-109-5	6-11	B139-111	6-16	B139-202	—	B16-68	—	B1-72	—	B1-70	—	C89-928	—	B1-76	—	C89-909-6	6-19	B139-316-2	6-4	D139-190
435A(WAR)	12.4-18GHz	B139-274	6-6	C139-168-4	6-7-6	C139-109-6	6-11	B139-111	6-16	B139-202	—	B16-67 B16-70 [1]	—	B1-72	—	B1-70	—	C89-928	—	B1-76	—	C89-909-6	6-19	B139-316-2	6-4	D139-190
442A(AV)	1.7-4.2GHz	B139-271	6-6	C139-168-3	6-7-7	C139-109-7	6-11	B139-111	6-17	B139-275	—	B16-61	—	B1-72	—	C89-910-2	—	C89-928	—	N/A	—	C89-909-3	—	N/A	6-4	D139-190

4[ ][ ]A/B-[ ][ ]

- H = HIGH POWER OUTPUT ACROSS BAND [1]
- R = REAR PANEL R.F. OUTPUT CONNECTOR
- -1 INTERNAL LEVELING INCLUDES A7 AND A8 [2]
- -2 UNLEVELED - MULTIBAND SYSTEM ONLY [3]
  4 NOT USED IN MULTIBAND SYSTEM
- -03 PULSE MODULATION INPUT THRU REAR PANEL CONNECTOR [6]
- INTERAL LEVELING INCLUDES A7, A8 AND A10 [5]
- INCLUDES A14 FOR MODEL 438, A5 FOR MODELS 431 AND 442 [8]
- BASIC MODEL NUMBER [7]

LHIJ —

MODEL	FREQ RANGE	SCALE PART NUMBER	LEVELER A1		TUNING and BIAS SUPPLY A2		AUX REF SUPPLY A3		SYMMETRICAL SWEEP SWITCH A4		CONTROL LOGIC A5		CRYSTAL DETECTOR A6		SOLID STATE OSCILLATOR A7		OSCILLATOR/ FILTER A8		AMPLIFIER A9		DIRECTIONAL COUPLER A10		SOLID STATE SWITCH A11 & A12		MIXER A13		STEP ATTENUATOR A14 [8]		BASIC CHASSIS ASSEMBLY	
			TABLE NO.	PART NO.	TABLE NO.	PART NO.	TABLE NO.	PART NO.	TABLE NO.	PART NO.	TABLE NO.	PART NO.	—	PART NO.	—	PART NO.	—	PART NO.	—	PART NO.	—	PART NO.	—	PART NO.	—	PART NO.	—	PART NO.	—	PART NO.	TABLE NO.	PART NO.
438A(WE)	.01-2 GHz	B139-338	6-6	C139-168-1	6-10	C139-107-3	6-11	B139-111	6-12	B139-199	6-19	C139-297	—	MP576-008	—	MP571-005	—	C139-243	—	MP250-035	—	C89-911	—	C139-303-1 C139-303-2	—	MP580-005	—	C89-909-7		
438A(OM)	.01-2 GHz	B139-338	6-6	C139-168-1	6-7-8	C139-109-8	6-21	A139-476	6-12	B139-199	6-20	C139-459	—	C89-928	—	B16-77	—	C139-482	—	MP250-035	—	C89-911	—	C139-533 NOT USED	—	—	—	C89-909-7	6-5	D139-489

Table 6-2. Model/Assembly Cross Reference

TABLE 6-2-1
MODEL/COMPONENT CROSS REFERENCE

MODEL	Q1		Q2		R5		R6		R7		CR1		CR2	
	WE #	Desc.	WE #	Desc.	WE #	Desc.	WE #	Desc.	WE #	Desc.	WE #	Desc.	WE #	Desc.
431A, 438A (WE)	12-177	MJ900	–	–	–	–	–	–	–	–	–	–	–	–
431A, 438A (OM)	12-177	MJ900	12-178	MJ1000	26-90-34R8	34.8 10W	26-8-15	15Ω 25W	–	–	–	–	–	–
432A (AV)	12-177	MJ900	12-178	MJ1000	26-90-34R8	34.8 10W	–	–	–	–	12-241	Unitrode UZ5722	12-223	1N4733A
433A (AV)	12-177	MJ900	12-178	MJ1000	26-91-11	11Ω 25W	–	–	–	–	12-236	Unitrode UZ5717	12-223	1N4733A
433A (WJ)	12-178	MJ1000	–	–	–	–	–	–	–	–	–	–	–	–
434A (VA)	12-177	MJ900	12-178	MJ1000	26-91-9R76	9.76 25W	–	–	26-8-8	8Ω 25W	*	*	–	–
434A (WJ)	12-178	MJ1000	12-178	MJ1000	26-92-7R5	7.5Ω 50W	–	–	26-8-8	8Ω 25W	*	*	–	–
435A (VA)	12-177	MJ900	12-178	MJ1000	26-92-6R8	6.8Ω 50W	–	–	26-8-8	6Ω 25W	*	*	–	–
435A (WJ)	12-178	MJ1000	12-178	MJ1000	26-92-5R6	5.6Ω 50W	–	–	26-8-8	6Ω 25W	*	*	–	–
442A (AV)	12-177	MJ900	12-178	MJ1000	26-90-34R8	34.8 10W	–	–	–	–	12-241	Unitrode UZ5722	12-223	1N4733A

*Selected at Test

TABLE 6-3. BASIC CHASSIS ASSEMBLY – VARACTOR (D139-189), PARTS LIST

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A1		See Table 6-2		
A2		See Table 6-2		
A3		See Table 6-2		
A4		See Table 6-2		
A5		See Table 6-2		
A6		See Table 6-2		
A7		See Table 6-2		
A8		See Table 6-2		
A9		See Table 6-2		
A10		See Table 6-2		
A11		See Table 6-2		
DS1	12-191	Lamp, Indicator	50434	5082-4403
DS2	12-191	Lamp, Indicator	50434	5082-4403
J1	62-76	Connector, Receptacle	13511	26-221
J2	63-5	Connector, Jack BNC		UG1094/U
J3	63-5	Connector, Jack BNC		UG1094/U
J4		Not Used		UG1094/U
J5	63-5	Connector, Jack BNC		UG1094/U
P1	62-161	Connector, Plug 36 Pin	13511	57-10360
Q1		See Table 6-2-1		
R1/R2 △1 △2	B20-190	Res, Vari Tandem, 1K	93459	
R3 △1 △2	25-25-100	Res, 100 ohm, 5%, ¼W		RC07GF101J
R4 △1	20-193-1000	Res, 1K, 10%, ½W	50139	YN1024
S1	55-51	Switch, Toggle SPDT	09353	7101-P4P 2BE

△1 Not used in Multiband System

△2 Not used in B option

TABLE 6-4. BASIC CHASSIS ASSEMBLY – YIG (D139-190), PARTS LIST

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A1		See Table 6-2		
A2		See Table 6-2		
A3		See Table 6-2		
A4		See Table 6-2		
A5		See Table 6-2		
A6		See Table 6-2		
A7		See Table 6-2		
A8		See Table 6-2		
A9		See Table 6-2		
A10		See Table 6-2		
A11		See Table 6-2		
CR1		See Table 6-2-1		
CR2		See Table 6-2-1		
DS1	12-191	Lamp Indicator	50434	5082-4403
DS2	12-191	Lamp Indicator	50434	5082-4403
J1	62-76	Connector, Receptacle	13511	26-221
J2	63-5	Connector, Jack BNC		UG1094/U
J3	63-5	Connector, Jack BNC		UG1094/U
J4		Not Used		
J5	63-5	Connector, Jack BNC		UG1094/U
P1	62-161	Connector, Jack BNC	13511	57-10360
Q1		See Table 6-2-1		
Q2		See Table 6-2-1		
R1/R2 △1 △2	B20-190	Res, Vari Tandem 1K	93459	
R3 △1 △2	25-25-100	Res, 100 ohm, 5%, ¼W		RC07GF101J
R4 △1	20-193-1000	Res, Vari, 1K, 10%, ½W	50139	YN102U
R5		See Table 6-2-1		
R6	26-8-15	Res, 15ohm, 5%, 25W	09969	RH25
R7		See Table 6-2-1		
S1	55-51	Switch, Toggle Spot	09353	7101-PYP2BE

△1 Not used in Multiband System

△2 Not used in B option

TABLE 6-5. MODEL 438A-1 (OM) ASSEMBLY (D139-489) PARTS LIST

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A1	C139-168-1	Leveler, P.C. Bd. Assembly	93459	
A2	C139-109-8	Tuning & Bias Supply Assembly	93459	
A3	A139-476	Heater P.C. Bd. Assembly	93459	
A4	B139-199	Symm. Sweep Sw. Assembly	93459	
A5	C139-459	Control Logic Assembly	93459	
A6	C89-928	Crystal Detector	93459	
A7	B16-77	Solid State Osc. (Yig)	93459	
A8	C139-482	Osc/Filter/Mixer Assembly	93459	
A9	MP250-035	10 MHz to 1 GHz Amplifier	93459	
A10	C89-911	Directional Coupler (1-2)	93459	
A11	C139-533	R.F. Solid State Switch	93459	
A12		Not Used		
A13		Not Used		
A14		See Table 6-2.		
C1	34-22-R1	Cap, 0.1 μf, 10%, 50V		CK06BX104K
DS1	12-191	Lamp, Indicator	50434	5082-4403
DS2	12-191	Lamp, Indicator	50434	5082-4403
DS3	12-191	Lamp, Indicator	50434	5082-4403
DS4	12-191	Lamp, Indicator	50434	5082-4403
J1	62-76	Connector, Receptacle	13511	26-221
J2	63-5	Connector, BNC		UG1094/U
J3	63-5	Connector, BNC		UG1094/U
J4	62-76	Not Used		UG1094/U
J5	63-5	Connector, BNC		UG1094/U
P1	62-161	Connector, Plug 36 Pin	13511	57-10360
Q1	12-177	Transistor	04713	MJ900
Q2	12-178	Transistor	04713	MJ1000
R1, R2 ⚠1	B20-190	Res, Vari Tandem, 1K, ½W	93459	
R3 ⚠1	25-25-100	Res, 100 ohm, 5%, ¼W		RC07GF101J
R4	20-193-1000	Res, Vari, 1K, 10%, ½W	50139	YN102U
R5	26-90-34R8	Res, 34.8 ohm, 1%, 10W	09969	RH-10
R6	26-8-15	Res, 15 ohm, 5%, 25W	09969	RH-25
S1	55-51	Switch, Toggle SPDT	09353	7101-P4P2BE
S2	57-16	Switch, Lever 2P4T	76854	Type 184

⚠1 Not used in B option

TABLE 6-6. ASSEMBLY A1, LEVELER (FOR RF UNIT MODELS 431A, 432A, 433A, 434A, 435A, AND 438A) PARTS LIST

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
		NOTE Table 6-6 represents a combined parts list for Assembly A1, Part Numbers C-139-168-1 through C-139-168-4. Refer to Table 6-2 to determine which part number is used with a specific Model RF Unit. Unless indicated, all assemblies contain the same value parts. Items peculiar to a specific assembly are identified by the assembly part number in parenthesis directly below the part number.		
A1	C-139-168-1	Circuit Board Assembly, Leveler	93459	
A1	C-139-168-2	Circuit Board Assembly, Leveler	93459	
A1	C-139-168-3	Circuit Board Assembly, Leveler	93459	
A1	C-139-168-4	Circuit Board Assembly, Leveler	93459	
A1C1	34-21-56	Cap, 56 pf, 10%, 200V		CK05BX560K
A1C2	34-22-R1	Cap, 0.1 µf, 10%, 50V		CK06BX104K
A1C3		Cap, Selected at factory		
A1C4	34-22-R1	Cap, 0.1 µf, 10%, 5V		CK06BX104K
A1C5	34-21-R0022	Cap, 2200 pf, 10%, 200V		CK06BX222K
A1C6	34-21-82	Cap, 82 pf, 10%, 200V		CK05BX820K
A1C7		Not Used		
A1C8	34-21-100	Cap, 100 pf, 10%, 200V		CK05BX101K
A1C9	34-21-220	Cap, 220 pf, 10%, 200V		CK05BX221K
A1C10	34-21-3R3	Cap, 3.3 pf, 5%	09021	9209-33905
A1C11	34-22-R1	Cap, 0.1 µf, 10%, 50V		CK06BX104K
A1C12	34-22-R1	Cap, 0.1 µf, 10%, 50V		CK06BX104K
A1C13	34-21-56	Cap, 56 pf, 10%, 200V		CK05BX560K
A1C14	34-22-R1	Cap, 0.1 µf, 10%, 50V		CK06BX104K
A1C15	34-22-R1	Cap, 0.1 µf, 10%, 50V		CK06BX104K
A1C16	34-21-1000	Cap, 1000 pf, 10%, 200V		CK0513X102K
A1C17	34-21-R0022	Cap, 2200 pf, 10%, 200V		CK06BX222K
A1C18	34-21-470	Cap, 470 pf, 10%, 200V		CK05BX471K
A1C19	34-21-100	Cap, 100 pf, 10%, 200V		CK05BX101K
A1C20	34-22-R1	Cap, 0.1 µf, 10%, 50V		CK06BX104K
A1C21	31-81	Cap, 10 µf, 10%, 25V	31433	T362B106M025
A1C22	31-81	Cap, 10 µf, 10%, 25V	31433	T362B106M025
A1C23	34-21-220	Cap, 220 pf, 10%, 200V		CK05BX221K
A1C24	31-78	Cap, 1 µf, 10%, 25V	31433	T362A105M035
A1C25	34-22-R1	Cap, 0.1 µf, 10%, 50V		CK06BX104K
A1C26	31-78	Cap, 1 µf, 10%, 25V	31433	T362A105M035
A1C27	34-22-R1	Cap, 0.1 µf, 10%, 50V		CK06BX104K
A1C28	34-23-2R2	Cap, 2.2 µf, 10%, 50V	01884	7C023225X050
A1C29	34-21-150	Cap, 150 pf, 10%, 200V		CK05BX151K
A1CR1	12-51	Diode		1N914B

TABLE 6-6. ASSEMBLY A1, LEVELER (FOR RF UNIT MODELS 431A, 432A, 433A, 434A, 435A, AND 438A) PARTS LIST (cont)

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A1CR2	12-51	Diode		1N914B
A1CR3	12-51	Diode		1N914B
A1CR4	12-51	Diode		1N914B
A1CR5	12-51	Diode		1N914B
A1CR6	12-51	Diode		1N914B
A1CR7	12-51	Diode		1N914B
A1CR8	12-51	Diode		1N914B
A1CR9	12-51	Diode		1N914B
A1CR10	12-51	Diode		1N914B
A1CR11	12-51	Diode		1N914B
A1CR12	12-51	Diode		1N914B
A1CR13	12-51	Diode		1N914B
A1CR14	12-51	Diode		1N914B
A1CR15	12-51	Diode		1N914B
A1CR16	12-51	Diode		1N914B
A1CR17	12-50	Diode, Zener		1N751A
A1CR18	12-50	Diode, Zener		1N751A
A1IC1	12-195	Amplifier, Operational	93459	
A1IC1	12-195	Amplifier, Operational	93459	
A1IC3	12-163	Quad. Nand Gate	04713	MC846P
A1IC4	12-192	Amplifier, Operational	04713	MC1458P
A1K1	47-29	Relay	12300	JRM1049
A1Q1	12-139	Transistor		2N4401
A1Q2	12-139	Transistor		2N4401
A1Q3	12-140	Transistor		2N4403
A1Q4	12-139	Transistor		2N4401
A1Q5	12-140	Transistor		2N4403
A1Q6	12-139	Transistor		2N4401
A1Q7	12-139	Transistor		2N4401
A1Q8	12-139	Transistor		2N4401
A1Q9	12-139	Transistor		2N4401
A1Q10	12-140	Transistor		2N4403
A1Q11	12-139	Transistor		2N4401
A1Q12	12-139	Transistor		2N4401
A1Q13	12-140	Transistor		2N4403
A1Q14	12-139	Transistor		2N4401
A1Q15	12-140	Transistor		2N4403
A1Q16	12-140	Transistor		2N4403
A1Q17	12-139	Transistor		2N4401
A1Q18	12-202	Transistor		2N4092
A1Q19	12-139	Transistor		2N4401
A1Q20	12-139	Transistor		2N4401
A1Q21	12-139	Transistor		2N4401
A1Q23	12-139	Transistor		2N4401

TABLE 6-6. ASSEMBLY A1, LEVELER (FOR RF UNIT MODELS 431A, 432A, 433A, 434A, 435A, AND 438A) PARTS LIST (cont)

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A1R1	25-25-3300	Res, 3.3K, 5%, ¼W		RC07GF332J
A1R2	25-20-845	Res, 845 ohm, 1%, 1/8W		RN60C8450F
A1R3	25-25-150	Res, 150 ohm, 5%, ¼W		RC07GF151J
A1R4	25-25-820	Res, 820 ohm, 5%, ¼W		RC07GF821J
A1R5	25-25-1800	Res, 1.8K 5%, ¼W		RC07GF182J
A1R6	25-25-220	Res, 220 ohm, 5%, ¼W		RC07GF221J
A1R7	25-25-100	Res, 100 ohm, 5%, ¼W		RC07GF101J
A1R8	25-25-15K	Res, 15K, 5%, ¼W		RC07GF153J
A1R9	25-20-2150	Res, 2.15K, 1%, 1/8W		RN60C2151F
A1R10	25-28-330	Res, 330 ohm, 5%, ½W		RC20GF331J
A1R11	25-25	Res, Selected at test, 5%, ¼W		
A1R12	25-25-220	Res, 220 ohm, 5%, ¼W		RC07GF221J
A1R13	25-28-200	Res, 200 ohm, 5%, ½W		RC20GF201J
A1R14	25-25-100	Res, 100 ohm, 5%, ¼W		RC07GF101J
A1R15	25-25-1000	Res, 1000 ohm, 5%, ¼W		RC07GF102J
A1R16	20-184	Res, Variable, 500 ohm	73138	89P
A1R17	25-25-4700	Res, 4.7K, 5%, ¼W		RC07GF472J
A1R18	25-25-1000	Res, 1000 ohm, 5%, ¼W		RC07GF102J
A1R19	25-25-1500	Res, 1.5K, 5%, ¼W		RC07GF152J
A1R20	25-20-6040	Res, 6.04K, 1%, 1/8W		RN60C6041F
A1R21	25-25-4700	Res, 4.7K, 5%, ¼W		RC07GF472J
A1R22	25-25-1800	Res, 1.8K, 5%, ¼W		RC07GF182J
A1R23	25-20-1470	Res, 1.47K, 1%, 1/8W		RN60C1471F
A1R24	25-25-560	Res, 560 ohm, 5%, ¼W		RC07GF561J
A1R25	25-25-1000	Res, 1000 ohm, 5%, ¼W		RC07GF102J
A1R26	25-25-3000	Res, 3K, 5%, ¼W		RC07GF302J
A1R27		Selected at test		
A1R28	25-25-33K	Res, 33K, 5%, ¼W		RC07GF333J
A1R29	25-25-15K	Res, 15K, 5%, ¼W		RC07GF153J
A1R30	25-25-3300	Res, 3.3K, 5%, ¼W		RC07GF332J
A1R31	25-25-150	Res, 150 ohm, 5%, ¼W		RC07GF151J
A1R32	25-25-2200	Res, 2.2K, 5%, ¼W		RC07GF222J
A1R33	25-25-33K	Res, 33K, 5%, ¼W		RC07GF333J
A1R34	25-25-5600	Res, 5.6K, 5%, ¼W		RC07GF562J
A1R35	25-25-1500	Res, 1.5K, 5%, ¼W		RC07GF152J
A1R36	25-25-1500	Res, 1.5K, 5%, ¼W		RC07GF152J
A1R37	25-25-33K	Res, 33K, 5%, ¼W		RC07GF333J
A1R38	25-25-5600	Res, 5.6K, 5%, ¼W		RC07GF562J
A1R39	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A1R40	25-25-330K	Res, 330K, 5%, ¼W		RC07GF354J
A1R41	25-25-100K	Res, 100K, 5%, ¼W		RC07GF104J
A1R42	25-25-2200	Res, 2.2K, 5%, ¼W		RC07GF222J
A1R43	25-25-10K (C-139-168-1, -2, and -4)	Res, 10K, 5%, ¼W		RC07GF103J

TABLE 6-6. ASSEMBLY A1, LEVELER (FOR RF UNIT MODELS 431A, 432A, 433A, 434A, 435A, AND 438A) PARTS LIST (cont)

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A1R44	20-189-50K	Res, Variable, 50K	73138	89P
A1R45	25-25-1000	Res, 1000 ohm, 5%, ¼W		RC07GF102J
A1R46	25-25-1000	Res, 1000 ohm, 5%, ¼W		RC07GF102J
A1R47	25-25-51K	Res, 51K, 5%, ¼W		RC07GF513J
A1R48	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A1R49	25-25-5600	Res, 5.6K, 5%, ¼W		RC07GF562J
A1R50	25-25-2200	Res, 2.2K, 5%, ¼W		RC07GF222J
A1R51	25-25-3300 (C-139-168-1, -2, and -4)	Res, 3.3K, 5%, ¼W		RC07GF332J
A1R51	25-25-6800 (-139-168-3)	Res, 6.8K, 5%, ¼W		RC07GF682J
A1R52	25-25-150	Res, 150 ohm, 5%, ¼W		RC07GF151J
A1R53	25-25-150	Res, 150 ohm, 5%, ¼W		RC07GF151J
A1R54	25-25-150	Res, 150 ohm, 5%, ¼W		RC07GF151J
A1R55	25-25-150	Res, 150 ohm, 5%, ¼W		RC07GF151J
A1R56	25-25-150	Res, 150 ohm, 5%, ¼W		RC07GF151J
A1R57	25-25-10	Res, 10 ohm, 5%, ¼W		RC07GF100J
A1R58	25-25-220	Res, 220 ohm, 5%, ¼W		RC07GF221J
A1R59	25-25-150	Res, 150 ohm, 5%, ¼W		RC07GF151J
A1R60	25-25-2200	Res, 2.2K, 5%, ¼W		RC07GF222J
A1R61	25-25-3300	Res, 3.3K, 5%, ¼W		RC07GF332J
A1R62	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A1R63	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A1R64	25-25-56K	Res, 56K, 5%, ¼W		RC07GF563J
A1R65	25-25-150K	Res, 150K, 5%, ¼W		RC07GF151J
A1R66	25-25-1500	Res, 1500K, 5%, ¼W		RC07GF152J
A1R67	25-25-3300	Res, 3.3K, 5%, ¼W		RC07GF332J
A1R68	25-25-2200	Res, 2.2K, 5%, ¼W		RC07GF222J
A1R69	25-25-100K	Res, 100K, 5%, ¼W		RC07GF104J
A1R70	25-25-4700	Res, 4.7K, 5%, ¼W		RC07GF472J
A1R71	25-25-2200	Res, 2.2K, 5%, ¼W		RC07GF222J
A1R72	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A1R73	25-25-27K	Res, 27K, 5%, ¼W		RC07GF273J
A1R74	25-25-5600	Res, 5.6K, 5%, ¼W		RC07GF562J
A1S1	B55-50	Switch, Pushbutton	93459	
A1S2	55-52	Switch, Slide DPDT	95146	MSS2250K

TABLE 6-7. ASSEMBLY A2, YIG TUNING AND BIAS SUPPLY, MASTER PARTS LIST

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
		NOTE Table 6-7 represents a master parts list for Assembly A2: Part Numbers C-139-109-1 through C-139-109-8. Refer to Table 6-2 to determine which part number is used with a specific Model RF Unit. Also, refer to Tables 6-7-1 through 6-7-8 (as indicated throughout Table 6-7 for component values peculiar to the respective assemblies.		
A2	C-139-109	Circuit Board Assembly, YIG Tuning and Bias Supply	93459	
A2C1		See Specific Parts List		
A2C2	34-21-150	Cap, 150 pf, 10%, 200V		CK05BX151K
A2C3	34-21-RO1	Cap, 0.01 μf, 10%, 200V		CK06BX103K
A2C4	34-21-RO1	Cap, 0.01 μf, 10%, 200V		CK06BX103K
A2C5		See Specific Parts List		
A2C6	34-22-RO47	Cap, 0.047 μf, 10%, 100V		CK06BX473K
A2C7	34-21-4700	Cap, 4700 pf, 10%, 200V		CK06BX472K
A2C8	34-21-RO1	Cap, 0.01 μf, 10%, 200V		CK06BX103K
A2C9	34-21-RO1	Cap, 0.01 μf, 10%, 200V		CK06BX103K
A2C10	34-21-R0033	Cap, 0.0033 μf, 10%, 200V		CK06BX332K
A2C11	34-21-R022	Cap, 0.022 μf, 10%, 50V		CK06BX222K
A2C12	34-21-R0047	Cap, 0.0047 μf, 10%, 200V		CK06BX472K
A2C13	34-21-R0033	Cap, 0.0033 μf, 10%, 200V		CK06BX332K
A2C14		See Specific Parts List		
A2C15	34-23-R22	Cap, 0.22 μf, 20%, 50V	01884	7C023224X0500D
A2C16		See Specific Parts List		
A2C17	34-21-68	Cap, 68 pf, 10%, 200V		CK05BX680K
A2C18	34-21-R1	Cap, 0.1 μf, 10%, 200V		CK06BX104K
A2C19	34-21-150	Cap, 150 pf, 10%, 200V		CK05BX151K
A2C20	34-21-R1	Cap, 0.1 μf, 10%, 200V		CK06BX104K
A2C21	34-23-R47	Cap, 0.47 μf, 20%, 50V	01884	7C023474X0500F
A2C22	34-23-R33	Cap, 0.33 μf, 20%, 50V	01884	7C023334X0500E
A2C23	34-21-R001	Cap, 0.001 μf, 10%, 200V		CK05BX102K
A2C24	34-21-R001	Cap, 0.001 μf, 10%, 200V		CK05BX102K
A2C25	34-22-R047	Cap, 0.047 μf, 10%, 100V		CK05BX470K
A2C26	34-21-470	Cap, 470 pf, 10%, 200V		CK05BX471K
A2C27	34-23-2R2	Cap, 2.2 μf, 20%, 50V	01884	7C023225X0500F
A2C28	34-21-R01	Cap, 0.01 μf, 10%, 200V		CK06BX103K
A2C29		See Specific Parts List		
A2C30	31-80	Cap, 10 μf, 35V	31433	T362C106M035
A2C31	34-23-R47	Cap, 0.47 μf, 20%, 50V	01884	7C023474X0500F
A2C32	34-21-R01	Cap, 0.01 μf, 10%, 200V		CK06BX103K
A2C33	34-21-680	Cap, 680 pf, 10%, 200V		CK05BX681K
A2CR1	12-99	Diode		1N483B
A2CR3	12-99	Diode		1N483B

TABLE 6-7. ASSEMBLY A2, YIG TUNING AND BIAS SUPPLY, MASTER PARTS LIST (cont)

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A2CR4	12-99	Diode		1N483B
A2CR5	12-99	Diode		1N483B
A2CR6	12-204	Diode, Zener		1N750A
A2CR7	12-215	SCR		2N4441
A2CR8	12-110	Diode		1N4383
A2CR9	12-99	Diode		1N483B
A2CR10	12-99	Diode		1N483B
A2CR11	12-99	Diode		1N483B
A2CR12	12-110	Diode		1N4383
A2CR13	12-196	Diode, Zener		1N4744A
A2CR14	12-99	Diode		1N483B
A2CR15	12-99	Diode		1N483B
A2CR16	12-99	Diode		1N483B
A2CR17	12-99	Diode		1N483B
A2CR18	12-99	Diode		1N483B
A2CR19	12-99	Diode		1N483B
A2CR20	12-99	Diode		1N483B
A2CR21	12-99	Diode		1N483B
A2CR22	12-99	Diode		1N483B
A2CR23	12-99	Diode		1N483B
A2CR24	12-99	Diode		1N483B
A2CR25	12-99	Diode		1N483B
A2CR26	12-99	Diode		1N483B
A2CR27	12-99	Diode		1N483B
A2CR28	12-99	Diode		1N483B
A2CR29	12-99	Diode		1N483B
A2CR30	12-99	Diode		1N483B
A2CR31	12-99	Diode		1N483B
A2CR32	12-99	Diode		1N483B
A2CR33	12-99	Diode		1N483B
A2CR34	12-99	Diode		1N483B
A2CR35	12-134	Diode, Zener		1N756A
A2CR36	12-99	Diode		1N483B
A2CR37	12-99	Diode		1N483B
A2CR38	12-99	Diode		1N483B
A2CR39	12-99	Diode		1N483B
A2CR40	12-99	Diode		1N483B
A2CR41	12-99	Diode		1N483B
A2CR42	12-99	Diode		1N483B
A2CR43	12-99	Diode		1N483B
A2CR44	12-99	Diode		1N483B
A2CR45	12-99	Diode		1N483B
A2CR46		See Specific Parts List		
A2CR47		See Specific Parts List		
A2CR48	12-51	Diode		1N914B
A2CR49		Not Used		
A2CR50	12-51	Diode		1N914B
A2CR51	12-51	Diode		1N914B

TABLE 6-7. ASSEMBLY A2, YIG TUNING AND BIAS SUPPLY, MASTER PARTS LIST (cont)

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A2F1		See Specific Parts List		
A2F2		See Specific Parts List		
A2IC1	12-165	Circuit, Integrated	27014	LM301AH
A2IC2	12-165	Circuit, Integrated	27014	LM301AH
A2IC3	12-165	Circuit, Integrated	27014	LM301AH
A2IC4	12-192	Amplifier, Dual Operational	04713	MC1458P
A2IC5	12-192	Amplifier, Dual Operational	04713	MC1458P
A2IC6	12-192	Amplifier, Dual Operational	04713	MC1458P
A2IC7	12-192	Amplifier, Dual Operational	04713	MC1458P
A2IC8	12-172	Array	02735	CA3046
A2K1	47-30	Relay, Reed	70109	ARA1-130062
A2Q1		See Specific Parts List		
A2Q2	12-139	Transistor		2N4401
A2Q3	12-140	Transistor		2N4403
A2Q4	12-194	Transistor	04713	MPSU55
A2Q5	12-139	Transistor		2N4401
A2Q6	12-140	Transistor		2N4403
A2Q7	12-140	Transistor		2N4403
A2Q8	12-222	Transistor		2N4045
A2Q9	12-222	Transistor		2N4045
A2Q10	12-140	Transistor		2N4403
A2Q11	12-206	Transistor	04713	MPSU05
A2Q12	12-194	Transistor	04713	MPSU55
A2Q13		Not Used		
A2Q14	12-139	Transistor		2N4401
A2Q15	12-139	Transistor		2N4401
A2Q16	12-202	FET		2N4092
A2Q17	12-140	Transistor		2N4403
A2Q18	12-140	Transistor		2N4403
A2Q19		See Specific Parts List		
A2R1	25-25-33	Res, 33 ohm, 5%, ¼W		RC07GF330J
A2R2		See Specific Parts List		
A2R3		See Specific Parts List		
A2R4	25-25-180	Res, 180 ohm, 5%, ¼W		RC07GF181J
A2R5		Not Used		
A2R6	25-25-15K	Res, 15K, 5%, ¼W		RC07GF153J
A2R7	25-25-22K	Res, 22K, 5%, ¼W		RC07GF223J
A2R8		See Specific Parts List		
A2R9	25-20-1960	Res, 1.96K, 1%, 1/8W		RN60C1961F
A2R10		See Specific Parts List		
A2R11	25-20-1960	Res, 1.96K, 1%, 1/8W		RN60C1961F
A2R12	25-25-2200	Res, 2.2K, 5%, ¼W		RC07GF222J
A2R13	25-25-220	Res, 220 ohm, 5%, ¼W		RC07GF221J
A2R14	25-8-470	Res, 470 ohm, 5%, ½W		RC20GF471J
A2R15	25-25-470	Res, 470 ohm, 5%, ¼W		RC07GF471J
A2R16	25-25-220	Res, 220 ohm, 5%, ¼W		RC07GF221J

TABLE 6-7. ASSEMBLY A2, YIG TUNING AND BIAS SUPPLY, MASTER PARTS LIST (cont)

REFERENCE DESIGNATION	# PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A2R17		See Specific Parts List		
A2R18	20-186	Res, Variable, 2K	73138	89P
A2R19	25-20-12R1K	Res, 12.1K, 1%, 1/8W		RN60C1212F
A2R20	25-25-1000	Res, 1K, 5%, ¼W		RC07GF102J
A2R21	25-25-470	Res, 470 ohm, 5%, ¼W		RC07GF471J
A2R22		See Specific Parts List		
A2R23	25-25-680	Res, 680 ohm, 5%, ¼W		RC07GF681J
A2R24	25-8-1800	Res, 1.8K, 5%, ½W		RC20GF182J
A2R25		See Specific Parts List		
A2R26	25-25-51K	Res, 51K, 5%, ¼W		RC07GF513J
A2R27	25-25-51K	Res, 51K, 5%, ¼W		RC07GF513J
A2R28	25-20-10K	Res, 10K, 1%, 1/8W		RN60C1002F
A2R29	25-28-10K	Res, 10K, 1%, 1/8W		RN60E1002F
A2R30		See Specific Parts List		
A2R31		See Specific Parts List		
A2R32	25-20-1M	Res, 1M, 1%, 1/8W		RN60C1004F
A2R33	25-20-1M	Res, 1M, 1%, 1/8W		RN60C1004F
A2R34	25-20-750K	Res, 750K, 1%, 1/8W		RN60C7503F
A2R35	25-20-1300	Res, 1.3K, 1%, 1/8W		RN60C1301E
A2R36	25-25-5100	Res, 5.1K, 5%, ¼W		RC07GF512J
A2R37	25-25-2000	Res, 2K, 5%, ¼W		RC07GF202J
A2R38	25-25-3300	Res, 3.3K, 5%, ¼W		RC07GF332J
A2R39	25-25-3300	Res, 3.3K, 5%, ¼W		RC07GF332J
A2R40	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A2R41	25-25-15K	Res, 15K, 5%, ¼W		RC07GF153J
A2R42	25-25-200	Res, 200 ohm, 5%, ¼W		RC07GF201J
A2R43	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A2R44	25-25-150	Res, 150 ohm, 5%, ¼W		RC07GF151J
A2R45	25-8-100	Res, 100 ohm, 5%, ½W		RC20GF101J
A2R46	25-25-10	Res, 10 ohm, 5%, ¼W		RC07GF100J
A2R47	25-25-10	Res, 10 ohm, 5%, ¼W		RC07GF100J
A2R48	25-25-2200	Res, 2.2K, 5%, ¼W		RC07GF222J
A2R49	25-8-100	Res, 100 ohm, 5%, ½W		RC20GF101J
A2R50	20-189-500K	Res, Variable, 500K	73138	89P
A2R51		See Specific Parts List		
A2R52		See Specific Parts List		
A2R53	25-25-4700	Res, 4.7K, 5%, ¼W		RC07GF472J
A2R54	25-20-475K	Res, 475K, 1%, 1/8W		RN60C4753F
A2R55	25-20-475K	Res, 475K, 1%, 1/8W		RN60C4753F
A2R56	25-25-330K	Res, 330K, 5%, ¼W		RC07GF334J
A2R57	25-25-56K	Res, 56K, 5%, ¼W		RC07GF563J
A2R58	25-25-2200	Res, 2.2K, 5%, ¼W		RC07GF222J
A2R59	25-25-150K	Res, 150K, 5%, ¼W		RC07GF154J
A2R60	25-25-390	Res, 390 ohm, 5%, ¼W		RC07GF391J
A2R61		See Specific Parts List		
A2R62	25-25-220	Res, 220 ohm, 5%, ¼W		RC07GF221J

TABLE 6-7. ASSEMBLY A2, YIG TUNING AND BIAS SUPPLY, MASTER PARTS LIST (cont)

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A2R63	25-23-2R43K	Res, 2.43K, 0.1%, 1/8W		RN60E2431B
A2R64	25-23-2R43K	Res, 2.43K, 0.1%, 1/8W		RN60E2431B
A2R65	25-23-100	Res, 100 ohm, 0.1%, 1/8W		RN60E1000B
A2R66	25-23-100	Res, 100 ohm, 0.1%, 1/8W		RN60E1000B
A2R67	25-25-220	Res, 220 ohm, 5%, ¼W		RC07GF221J
A2R68	25-25-1500	Res, 1.5K, 5%, ¼W		RC07GF152J
A2R69	25-23-243K	Res, 243K, 0.1%, 1/8W		RN60E2433B
A2R70	25-23-243K	Res, 243K, 0.1%, 1/8W		RN60E2433B
A2R71	25-25-470	Res, 470 ohm, 5%, ¼W		RC07GF471J
A2R72	25-25-820	Res, 820 ohm, 5%, ¼W		RC07GF821J
A2R73	25-25-2200	Res, 2.2K, 5%, ¼W		RC07GF222J
A2R74	25-25-150K	Res, 150K, 5%, ¼W		RC07GF154J
A2R75	25-25-1R8M	Res, 1.8M, 5%, ¼W		RC07GF185J
A2R76	25-25-390	Res, 390 ohm, 5%, ¼W		RC07GF391J
A2R77	25-8-910	Res, 910 ohm, 5%, ½W		RC20GF911J
A2R78	25-25-1000	Res, 1K, 5%, ¼W		RC07GF102J
A2R79	25-20-221K	Res, 221K, 1%, 1/8W		RN60C2213F
A2R80	25-20-221K	Res, 221K, 1%, 1/8W		RN60C2213F
A2R81	25-25-39K	Res, 39K, 5%, ¼W		RC07GF393J
A2R82	25-25-51K	Res, 51K, 5%, ¼W		RC07GF513J
A2R83	25-20-68R1K	Res, 68.1K, 1%, 1/8W		RN60C6812F
A2R84	25-20-68R1K	Res, 68.1K, 1%, 1/8W		RN60C6812F
A2R85		See Specific Parts List		
A2R86	25-20-121K	Res, 121K, 1%, 1/8W		RN60C1213F
A2R87	20-189-100K	Res, Variable, 100K	73138	89P
A2R88		See Specific Parts List		
A2R89	20-189-200K	Res, Variable, 200K	73138	89P
A2R90	25-25-33K	Res, 33K, 5%, ¼W		RC07GF333J
A2R91	25-25-1800	Res, 1.8K, 5%, ¼W		RC07GF182J
A2R92	25-25-10M	Res, 10M, 5%, ¼W		RC07GF106J
A2R93	25-25-20K	Res, 20K, 5%, ¼W		RC07GF203J
A2R94	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A2R95	25-25-20K	Res, 20K, 5%, ¼W		RC07GF203J
A2R96	25-25-4700	Res, 4.7K, 5%, ¼W		RC07GF472J
A2R97	25-20-475K	Res, 475K, 1%, 1/8W		RN60C4753F
A2R98	25-20-475K	Res, 475K, 1%, 1/8W		RN60C4753F
A2R99	25-25-20K	Res, 20K, 5%, ¼W		RC07GF203J
A2R100	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A2R101	25-25-120K	Res, 120K, 5%, ¼W		RC07GF124J
A2R102	25-25-6800	Res, 6.8K, 5%, ¼W		RC07GF682J
A2R103	25-25-220	Res, 220 ohm, 5%, ¼W		RC07GF221J
A2R104		See Specific Parts List		
A2R105		See Specific Parts List		
A2R106	25-25-2R2M	Res, 2.2M, 5%, ¼W		RC07GF225J
A2R107	25-20-150K	Res, 150K, 1%, 1/8W		RN60C1503F
A2R108	20-189-200K	Res, Variable, 200K		RC07GF473J
A2R109	25-25-47K	Res, 47K, 5%, ¼W		RC07GF473J

TABLE 6-7. ASSEMBLY A2, YIG TUNING AND BIAS SUPPLY, MASTER PARTS LIST (cont)

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A2R110	25-25-330K	Res, 330K, 5%, ¼W		RC07GF334J
A2R111	25-25-68K	Res, 68K, 5%, ¼W		RC07GF683J
A2R112	25-25-22K	Res, 22K, 5%, ¼W		RC07GF223J
A2R113	25-25-100K	Res, 100K, 5%, ¼W		RC07GF104J
A2R114	25-25-7500	Res, 7.5K, 5%, ¼W		RC07GF752J
A2R115	25-25-22K	Res, 22K, 5%, ¼W		RC07GF223J
A2R116	25-25-22K	Res, 22K, 5%, ¼W		RC07GF223J
A2R117	25-25-22K	Res, 22K, 5%, ¼W		RC07GF223J
A2R118	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A2R119	25-25-560K	Res, 560K, 5%, ¼W		RC07GF564J
A2R120	25-25-1500	Res, 1.5K, 5%, ¼W		RC07GF152J
A2R121	25-25-3300	Res, 3.3K, 5%, ¼W		RC07GF332J
A2R122	25-25-3300	Res, 3.3K, 5%, ¼W		RC07GF332J
A2R123	25-25-39K	Res, 39K, 5%, ¼W		RC07GF393J
A2R124	25-25-470	Res, 470 ohm, 5%, ¼W		RC07GF471J
A2R125		Not Used		
A2R126		Not Used		
A2R127		Not Used		
A2R128		Not Used		
A2R129		See Specific Parts List		
A2R130		See Specific Parts List		
A2R131	25-25-1800	Res, 1.8K, 5%, ¼W		RC07GF182J
A2R132	25-25-7500	Res, 7.5K, 5%, ¼W		RC07GF752J
A2R133	25-25-47K	Res, 47K, 5%, ¼W		RC07GF473J
A2R134		See Specific Parts List		
A2R135		See Specific Parts List		
A2R136		See Specific Parts List		
A2R137	25-25-1R8M	Res, 1.8M, 5%, ¼W		RC07GF185J
A2R138	25-20-10K	Res, 10K, 1%, 1/8W		RN60C1002F
A2R139		See Specific Parts List		
A2TP1-14	62-153	Quick Disconnect Pin	71279	4602970020300

TABLE 6-7-1. ASSEMBLY A2-432A (AVANTEK) YIG TUNING AND BIAS SUPPLY PARTS LIST

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
		NOTE This is a partial parts list for components unique to Assembly A2, C-139-109-1. Refer to Master Parts List, Table 6-7, for the complete parts list.		
A2	C139-109-1	Circuit Board Assembly, YIG Tuning and Bias Supply	93459	
A2C1	34-21-R0022	Cap, 0.0022 µf, 10%, 200V		CK06BX222K
A2C5	31-80	Cap, 10 µf, 35V	31433	T362C106M035
A2C14	34-21-1500	Cap, 0.0015 µf, 10%, 200V		CK05BX152K
A2C29	34-21-4700	Cap, 0.0047 µf, 10%, 200V		CK06BX472K
A2F1	52-1-¾	Fuse, ¾ amp.	71400	AGC¾amp
A2F2	52-1-¼	Fuse, ¼ amp.	71400	AGC¼amp
A2Q1	12-140	Transistor		2N4403
A2Q19	12-140	Transistor		2N4403
A2R2	26-20-R75	Res, 0.75 ohm, 5%, 2W		RC42GFR75J
A2R3	25-27-1800	Res, 1.8K, 5%, ½W		RC20GF182J
A2R8	25-20-20K	Res, 20K, 1%, 1/8W		RN60C2002F
A2R10	25-20-*	Res, 5.62K-7.15K		RN60C
A2R17	26-8-78R7	Res, 78.7 ohm, 1%, 3W		RW79U78R7F
A2R22		Res, 8.66 ohm, 1%, 1W	93459	
A2R25	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A2R30	25-28-*	Res, 1%, 1/8W (selected at test)		RN60E
A2R31	20-186	Res, Variable 2K	73138	89P
A2R51	25-25-51K	Res, 51K 5%, ¼W		RC07GF513J
A2R52	25-20-69R8K	Res, 69.8K, 1%, 1/8W		RN60C6982F
A2R61	25-25-100K	Res, 100K, 5%, ¼W		RC07GF104J
A2R85	25-8-9R1	Res, 9.1 ohm, 5%, ½W		RC20GF9R1J
A2R88	25-20-267K	Res, 267K, 1%, 1/8W		RN60C2673F
A2R104	20-184	Res, Variable 500 ohm,	73138	89P
A2R105	25-28-*	Res, 2.43K, 2.8K, 3.16K (selected at test)		RN60E
A2R129	25-20-348K	Res, 348K, 1%, 1/8W		RN60C3483F
A2R130	25-20-348K	Res, 348K, 1%, 1/8W		RN60C3483F

TABLE 6-7-2. ASSEMBLY A2-433A (AVANTEK) YIG TUNING AND BIAS SUPPLY PARTS LIST

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
	NOTE This is a partial parts list for components unique to Assembly A2, C-139-109-2. Refer to Master Parts List, Table 6-7, for the complete parts list.			
A2	C139-109-2	Circuit Board Assembly YIG Tuning and Bias Supply	93459	
A2C1	34-21-R0022	Cap, 0.0022 µf, 10%, 200V		CK06BX222K
A2C5	31-80	Cap, 10 µf, 35V	31433	T362C106M035
A2C14	34-21-R01	Cap, 0.01 µf, 10%, 200V		CK06BX103K
A2C16	34-21-4700	Cap, 0.0047 µf, 10%, 200V		CK06BX472K
A2C29	34-21-4700	Cap, 0.0047 µf, 10%, 200V		CK06BX472K
A2CR46	12-225	Diode, Zener		1N4749A
A2CR47	12-223	Diode		1N4733A
A2F1	52-1-¾	Fuse, ¾ amp.	71400	AGC ¾
A2F2	52-1-¾	Fuse, ¾ amp.	71400	AGC ¾
A2Q1	12-140	Transistor		2N4403
A2Q19	12-140	Transistor		2N4403
A2R2	26-20-R75	Res, 0.75 ohm, 5%, 2W		RC42GFR75J
A2R3	25-8-2400	Res, 2.4K, 5%, ½W		RC20GF242J
A2R8	25-20-15K	Res, 15K, 1%, 1/8W		RN60C1502F
A2R10	25-20-*	Res, 3.92-4.78K, 1%, 1/8W (Selected at Test)		RN60C
A2R17	26-30-78R7	Res, 78.7 ohm, 1%, 3W		RW79U7872F
A2R22	26-30-2R75	Res, 2.75 ohm, 1%, 3W		RW79U2751F
A2R25	25-25-3300	Res, 3.3K, 5%, ¼W		RC07GF332J
A2R30	25-28-*	Res, 1%, 1/8W (Selected at Test)		RN60E
A2R31	20-186	Res, Variable, 2K	73138	89P
A2R51	25-25-150K	Res, 150K, 5%, ¼W		RC07GF154J
A2R52	25-20-69R8K	Res, 69.8K, 1%, 1/8W		RN60C6982F
A2R61	25-25-56K	Res, 56K, 5%, ¼W		RC07GF563J
A2R85	25-8-9R1	Res, 9.1 ohm, 5%, ½W		RC20GF9R1J
A2R88	25-20-267K	Res, 267K, 1%, 1/8W		RN60C2673F
A2R104	20-184	Res, Variable 500 ohm	73138	89P
A2R105	25-28-*	Res, 2.43K, 2.8K, 3.16K		RN60E
A2R129	25-20-475K	Res, 475K, 1%, 1/8W		RN60C4753F
A2R130	25-20-475K	Res, 475K, 1%, 1/8W		RN60C4753F

TABLE 6-7-3. ASSEMBLY A2 - 434A (W.J.) YIG TUNING AND BIAS SUPPLY PARTS LIST

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
		NOTE This is a partial parts list for components unique to Assembly A2, C-139-109-3. Refer to Master Parts List, Table 6-7, for the complete parts list.		
A2	C139-109-3	Circuit Board Assembly YIG Tuning and Bias Supply	93459	
A2C1	34-21-R0033	Cap, 0.0033 μf, 10%, 200V		CK06BX332K
A2C5	31-80	Cap, 10 μf, 35V	31433	T362C106M035
A2C14	34-21-R0033	Cap, 0.0033 μf, 10%, 200V		CK06BX332K
A2C16	24-21-4700	Cap, 0.0047 μf, 10%, 200V		CK06BX422K
A2C29	34-21-6800	Cap, 0.0068 μf, 10%, 200V		CK05BX682K
A2F1	52-1-1.5	Fuse, 1½ amp.	71400	AGC 1½
A2F2	52-1-1.5	Fuse, 1½ amp.	71400	AGC 1½
A2Q1	12-139	Transistor		2N4401
A2Q19	12-139	Transistor		2N4401
A2R2	26-20-R43	Res, 0.43 ohm, 5%, 2W		RC42GFR43J
A2R3	25-8-2400	Res, 2.4K, 5%, ½W		RC20GF242J
A2R8	25-20-*	Res, 6.04-9.09K (Selected at Test)		RN60C
A2R10	25-20-*	Res, 97.6 ohm - 1.4K, 1%, 1/8W (Selected at Test)		RN60C
A2R22	26-30-1R87	Res, 1.87 ohm, 1%, 3W		RW79U1871F
A2R25	25-25-3900	Res, 3.9K, 5%, ¼W		RC07GF392J
A2R30	25-28-*	Res, 1%, 1/8W (Selected at Test)		RN60E
A2R31	20-186	Res, Variable 2K	73138	89P
A2R51	25-25-150K	Res, 150K, 5%, ¼W		RC07GF154J
A2R52	25-20-33R2K	Res, 33.2K, 1%, 1/8W		RN60C
A2R61	25-25-56K	Res, 56K, 5%, ¼W		RC07GF563J
A2R85	25-8-6R8	Res, 6.8 ohm, 5%, ½W		RC20GF6R8J
A2R88	25-20-169K	Res, 169K, 1%, 1/8W		RN60C1693F
A2R104	20-184	Res, Variable 500 ohm	73138	89P
A2R105	25-28-*	Res, 1.47K, 1.91K, 2.37K, 1%, 1/8W (Selected at Test)		RN60E
A2R129	25-20-475K	Res, 475K, 1%, 1/8W		RN60C4753F
A2R130	25-20-475K	Res, 475K, 1%, 1/8W		RN60C4753F

TABLE 6-7-4. ASSEMBLY A2-434A (VA) YIG TUNING AND BIAS SUPPLY PARTS LIST

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
	NOTE This is a partial parts list for components unique to Assembly A2, C-139-109-4. Refer to Master Parts List, Table 6-7, for the complete parts list.			
A2	C139-109-4	Circuit Board Assembly, YIG Tuning and Bias Supply	93459	
A2C1	34-21-R0022	Cap, 0.0022 μf, 10%, 200V		CK06BX222K
A2C5	31-80	Cap, 10 μf, 35V	31433	T362C106M035
A2C14	34-21-R01	Cap, 0.01 μf, 10%, 200V		CK06BX103K
A2C16	34-21-4700	Cap, 0.0047 μf, 10%, 200V		CK06BX472K
A2C29	34-21-6800	Cap, 0.0068 μf, 10%, 200V		CK05BX682K
A2F1	52-1-1	Fuse, 1 amp.	71400	AGC 1 amp
A2F2	52-1-1	Fuse, 1 amp.	71400	AGC 1 amp
A2Q1	12-140	Transistor		2N4403
A2Q19	12-140	Transistor		2N4403
A2R2	26-20-R62	Res, 0.62 ohm, 5%, 2W		RC42GFR62J
A2R3	25-8-3000	Res, 3K, 5%, ½W		RC20GF302J
A2R8	25-20-*	Res, 14K-18.7K, 1%, 1/8W (Selected at Test)		RN60C
A2R10	25-20-*	Res, 4.53K-5.49K, 1%, 1/8W (Selected at Test)		RN60C
A2R22	26-30-2R43	Res, 2.43 ohm, 1%, 3W		RW79U2R43
A2R25	25-25-3900	Res, 3.9K, 5%, ¼W		RC07GF392J
A2R30	25-28-*	Res, 1%, 1/8W (Selected at Test)		RN60E
A2R31	20-186	Res, Variable 2K	73138	89P
A2R51	25-25-100K	Res, 100K, 5%, ¼W		RC07GF104J
A2R52	25-20-33R2K	Res, 33.2K, 1%, 1/8W		RN60C3322F
A2R61	25-25-180K	Res, 180K, 5%, ¼W		RC07GF184J
A2R85	25-8-6R8	Res, 6.8 ohm, 5%, ½W		RC20GF6R8J
A2R88	25-20-169K	Res, 169K, 1%, 1/8W		RN60C1693F
A2R104	20-184	Res, Variable 500 ohm	73138	89P
A2R105	25-28-*	Res, 1.47K, 1.91K, 2,37K, 1%, 1/8W (Selected at Test)		RN60E
A2R129	25-20-178K	Res, 178K, 1%, 1/8W		RN60C1783F
A2R130	25-20-178K	Res, 178K, 1%, 1/8W		RN60C1783F
A2R139	25-25-*	Res, 5%, ¼W (Selected at Test)		Rco7GF

TABLE 6-7-5. ASSEMBLY A2-435A (W.J.) YIG TUNING AND BIAS SUPPLY PARTS LIST

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
	NOTE This is a partial parts list for components unique to Assembly A2, C-139-109-5. Refer to Master Parts List, Table 6-7, for the complete parts list.			
A2	C139-109-5	Circuit Board Assembly, YIG Tuning and Bias Supply	93459	
A2C1	34-21-R0033	Cap, 0.0033 µf, 10%, 200V		CK06BX332K
A2C5	31-80	Cap, 10 µf, 35V	31433	T362C106M035
A2C14	34-21-R01	Cap, 0.01 µf, 10%, 200V		CK06BX103K
A2C16	34-21-6800	Cap, 0.0068 µf, 10%, 200V		CK05BX682K
A2C29	34-21-6800	Cap, 0.0068 µf, 10%, 200V		CK05BX682K
A2F1	52-1-1.5	Fuse 1½ amp.	71400	ABC 1½ amp
A2F2	52-1-1.5	Fuse 1½ amp.	71400	AGC 1½ amp
A2Q1	12-139	Transistor		2N4401
A2Q19	12-139	Transistor		2N4401
A2R2	26-20-R40	Res, 0.4 ohm, 5%, 2W		RC42GFR40J
A2R3	25-8-2400	Res, 2.4K, 5%, ½W		RC20GF242J
A2R8	25-20-*	Res, 14K-18.7K, 1%, 1/8W (Selected at Test)		RN60C
A2R10	25-20-*	Res, 4.53K-5.49K, 1%, 1/8W (Selected at Test)		RN60C
A2R22	26-29-1R40	Res, 1.40 ohm, 1%, 5W		RN60C
A2R25	25-25-3900	Res, 3.9K, 5%, ¼W		RC07GF392J
A2R30	25-28-*	Res, 1%, 1/8W (Selected at Test)		RN60C
A2R31	20-184	Res, Variable 500 ohm	73138	89P
A2R51	25-25-150K	Res, 150K, 5%, ¼W		RC07GF154J
A2R52	25-20-26R7K	Res, 26.7K, 1%, 1/8W		RN60C2672F
A2R61	25-25-220K	Res, 220K, 5%, ¼W		RC07GF224J
A2R85	25-8-5R6	Res, 5.6 ohm 5%, ½W		RC20GF5R6J
A2R88	25-20-150K	Res, 150K, 1%, 1/8W		RN60C1503F
A2R104	20-189-200	Res, Variable 200 ohm	73138	89P
A2R105	25-28-*	Res, 1.54K, 1.62K, 1.74K (Selected at Test)		RN60E
A2R129	25-20-115K	Res, 115K, 1%, 1/8W		RN60C1153F
A2R130	25-20-115K	Res, 115K, 1%, 1/8W		RN60C1153F

TABLE 6-7-6. ASSEMBLY A2-435A (VA) YIG TUNING AND BIAS SUPPLY PARTS LIST

REFERENCE DESIGNATION	PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
	NOTE This is a partial parts list for components unique to Assembly A2, C-139-109-6. Refer to Master Parts List, Table 6-7, for the complete parts list.			
A2	C139-109-6	Circuit Board Assembly YIG Tuning and Bias Supply	93459	
A2C1	34-21-R0022	Cap, 0.0022 µf, 10%, 200V		CK06BX222K
A2C5	31-80	Cap, 10 µf, 35V	31433	T362C106M035
A2C14	34-21-R01	Cap, 0.01 µf, 10%, 200V		CK06BX103K
A2C16	34-21-6800	Cap, 0.0068 µf, 10%, 200V		CK05BX682K
A2C29	34-21-6800	Cap, 0.0068 µf, 10%, 200V		CK05BX682K
A2F1	52-1-1	Fuse, 1 amp.	71400	AGC 1 amp
A2F2	52-1-1.5	Fuse, 1½ amp.	71400	AGC 1½ amp
A2Q1	12-140	Transistor		2N4403
A2Q19	12-140	Transistor		2N4403
A2R2	26-20-R56	Res, 0.56 ohm, 5%, 2W	06486	BWH
A2R3	25-8-3000	Res, 3K, 5%, ½W		RC20GF302J
A2R8	25-20-*	Res, 14K-18.7K, 1%, 1/8W (Selected at Test)		RN60C
A2R10	25-20-*	Resistor, 4.53K-5.49K, 1%, 1/8W (Selected at Test)		RN60C
A2R22	26-29-1R40	Res, 1.40 ohm, 1%, 5W	09969	RW74
A2R25	25-25-3900	Res, 3.9K, 5%, ¼W		RC07GF392J
A2R30	25-28-*	Res, 1%, 1/8W, (Selected at Test)		RN60E
A2R31	20-184	Res, Variable 500 ohm	73138	89P
A2R51	25-25-150K	Res, 150K, 5%, ¼W		RC07GF154J
A2R52	25-20-26R7K	Res, 26.7K, 1%, 1/8W		RN60C2672F
A2R61	25-25-220K	Res, 220K, 5%, ¼W		RC07GF224J
A2R85	25-8-6R8	Res, 6.8 ohm, 5%, ½W		RC07GF6R8J
A2R88	25-20-150K	Res, 150K, 1%, 1/8W		RN60C1503F
A2R104	20-189-200	Res, Variable 200 ohm	73138	89P
A2R105	25-28-*	Res, 1.54K, 1.62K, 1.74K (Selected at Test), 1%, 1/8W		RN60E
A2R129	25-20-115K	Res, 115K, 1%, 1/8W		RN60C1153F
A2R130	25-20-115K	Res, 115K, 1%, 1/8W		RN60C1153F
A2R139	25-25-*	Res, 5%, ¼W, (Selected at Test)		RC07

TABLE 6-7-7. ASSEMBLY A2-442A (AVANTEK) YIG TUNING AND BIAS SUPPLY PARTS LIST

REFERENCE DESIGNATION	# PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
		NOTE This is a partial parts list for components unique to Assembly A2, C-139-109-7. Refer to Master Parts List, Table 6-7 for the complete parts list.		
A2	C139-109-7	Circuit Board Assembly YIG Tuning and Bias Supply	93459	
A2C1	34-21-R0022	Cap, 0.0022 µf, 10%, 200V		CK06BX222K
A2C5	31-80	Cap, 10 µf, 35V	31433	T362C106M035
A2C14	34-21-1500	Cap, 0.0015 µf, 10%, 200V		CK05BX152K
A2C16	34-21-R0022	Cap, 0.0022 µf, 10%, 200V		CK06BX222K
A2C29	34-21-4700	Cap, 0.0047 µf, 10%, 200V		CK06BX472K
A2F1	52-1-¾	Fuse, ¾ amp.	71400	AGC ¾ amp
A2F2	52-1-¼	Fuse, ¼ amp.	71400	AGC ¼ amp
A2Q1	12-140	Transistor		2N4403
A2Q19	12-140	Transistor		2N4403
A2R2	26-20-R75	Res, 0.75 ohm, 5%, 2W		RC42GFR75J
A2R3	25-8-1800	Res, 1.8K, 5%, ½W		RC20GF182J
A2R8	25-20-20K	Res, 20K, 1%, 1/8W		RN60C2002F
A2R10	25-20-*	Res, 5.62K-7.15K, 1%, 1/8W (Selected at Test)		RN60C
A2R17	26-30-78R7	Res, 78.7 ohm, 1%, 3W		
A2R22	26-67-8R66	Res, 8.66 ohm, 1%, 1W		RN75C8660F
A2R25	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A2R30	25-28-*	Res, 1%, 1/8W, (Selected at Test)		RN60E
A2R31	20-186	Res, Variable 2K	73138	89P
A2R51	25-25-51K	Res, 51K, 5%, ¼W		RC07GF513J
A2R52	25-20-69R8K	Res, 69.8K, 1%, 1/8W		RN60C6982F
A2R61	25-25-100K	Res, 100K, 5%, ¼W		RC07GF104J
A2R85	25-8-9R1	Res, 9.1 ohm, 5%, ½W		RC20GF9R1J
A2R88	25-20-267K	Res, 267K, 1%, 1/8W		RN60C2673F
A2R104	20-184	Res, Variable 500 ohm	73138	89P
A2R105	25-28-*	Res, 2.43K, 2.8K 3.16K (Selected at Test)		RN60E
A2R129	25-20-348K	Res, 348K, 1%, 1/8W		RN60C3483F
A2R130	25-20-348K	Res, 348K, 1%, 1/8W		RN60C3483F

TABLE 6-7-8. ASSEMBLY A2-438A-1 (O.M.) YIG TUNING AND BIAS SUPPLY PARTS LIST

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
	NOTE This is a partial parts list for components unique to Assembly A2, C-139-109-8. Refer to Master Parts List, Table 6-7, for the complete parts list.			
A2	C139-109-8	Circuit Board Assembly, YIG Tuning and Bias Supply	93459	
A2C1	34-21-R0022	Cap, 0.0022 µf, 10%, 200V		CK06BX222K
A2C5	31-80	Cap, 10 µf, 35V	31433	T362C106M035
A2C14	34-21-1500	Cap, 0.0015 µf, 10%, 200V		CK05BX152K
A2C16	34-21-R0022	Cap, 0.0022 µf, 10%, 200V		CK06BX222K
A2C29	34-21-4700	Cap, 0.0047 µf, 10%, 200V		CK06BX472K
A2CR47	12-223	Diode		1N4733A
A2F1	52-1-¾	Fuse, ¾ amp.	71400	AGC ¾ amp
A2F2	52-1-¼	Fuse, ¼ amp.	71400	AGC ¼ amp
A2Q1	12-140	Transistor		2N4403
A2Q19	12-140	Transistor		2N4403
A2R2	26-20-R75	Res, 0.75 ohm, 5%, 2W		RC42GFR75J
A2R3	25-8-1800	Res, 1.8K, 5%, ½W		RC20GF182J
A2R8	25-20-20K	Res, 20K, 1%, 1/8W		RN60C2002F
A2R10	25-20-*	Res, 1%, 1/8W, (Selected at Test)		RN60C
A2R22	26-27-8R66	Res, 8.66 ohm, 1%, 1W		RN75C8R66F
A2R25	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A2R30	25-28-*	Res, 1%, 1/8W, (Selected at Test)		RN60E
A2R31	20-186	Res, Variable 2K	73138	89P
A2R51	25-25-51K	Res, 51K, 5%, ¼W		RC07GF513J
A2R52	25-20-69R8K	Res, 69.8K, 1%, 1/8W		RN60C6982F
A2R61	25-25-51K	Res, 51K, 5%, ¼W		RC07GF513J
A2R85	25-8-*	Res, 5%, ½W, (Selected at Test)		RC20GF
A2R88	25-20-267K	Res, 267K, 1%, 1/8W		RN60C2673F
A2R104	20-184	Res, 500 ohm, Variable	73138	89P
A2R105	25-28-*	Res, (Selected at Test)		RN60E
A2R129	25-28-*	Res, (Selected at Test)		RN60E
A2R130	25-28-*	Res, (Selected at Test)		RN60E
A2R134	25-20-1R27M	Res, 1.27M, 1%, 1/8W		RN60D1264F
A2R135	25-28-*	Res, 1%, 1/8W, (Selected at Test)		RN60E
A2R136	25-28-*	Res, 1%, 1/8W, (Selected at Test)		

TABLE 6-8. ASSEMBLY A2-431A (W.E.) VARACTOR TUNING AND BIAS SUPPLY PARTS LIST

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A2	C139-107-1	Circuit Board Assembly Varactor Tuning and Bias Supply	93459	
A2C1	34-21-R0033	Cap, 0.0033 µf, 10%, 200V		CK06BX332K
A2C2	34-21-R47	Cap, 0.047 µf, 10%, 200V		CK05BX470K
A2C3	34-21-150	Cap, 150 pf, 10%, 200V		CK05BX151K
A2C4	31-80	Cap, 10 µf, 35V	31433	T362C106M035
A2C5	34-21-R01	Cap, 0.01 µf, 10%, 200V		CK06BX103K
A2C6	34-21-R01	Cap, 0.01 µf, 10%, 200V		CK06BX103K
A2C7	34-21-R01	Cap, 0.01 µf, 10%, 200V		CK06BX103K
A2C8	34-21-560	Cap, 560 pf, 10%, 200V		CK05BX561K
A2C9	34-22-R1	Cap, 0.1 µf, 10%, 200V		CK06BX104K
A2C10	34-22-R1	Cap, 0.1 µf, 10%200V		CK06BX104K
A2C11	34-21-1500	Cap, 1500 pf, 10%, 200V		CK05BX152K
A2C12	34-21-R01	Cap, 0.01 µf, 10%, 200V		CK06BX103K
A2C13	34-21-1500	Cap, 1500 pf, 10%, 200V		CK05BX152K
A2C14	34-21-82	Cap, 82 pf, 10%, 200V		CK05BX820K
A2C15	34-21-470	Cap, 470 pf, 10%, 200V		CK05BX471K
A2C16	34-23-2R2	Cap, 2.2 µf, 50V	01884	7C023225X500F
A2C17	34-23-R47	Cap, 0.47 µf, 50V	01884	7C023474X500E
A2C18	33-35-R22	Cap, 0.22 µf, 200V		
A2C19	34-21-R01	Cap, 0.01 µf, 10%, 200V		CK06BX103K
A2CR1	12-99	Diode		1N483B
A2CR2	12-99	Diode		1N483B
A2CR3	12-99	Diode		1N483B
A2CR4	12-215	SCR		2N4441
A2CR5	12-110	Diode		1N4383
A2CR6	12-204	Diode		1N483B
A2CR7	12-99	Diode		1N483B
A2CR8	12-99	Diode		1N483B
A2CR9	12-99	Diode		1N483B
A2CR10	12-99	Diode		1N483B
A2CR11	12-99	Diode		1N483B
A2CR12	12-99	Diode		1N483B
A2CR13	12-99	Diode		1N483B
A2CR14	12-99	Diode		1N483B
A2CR15	12-99	Diode		1N483B
A2CR16	12-99	Diode		1N483B
A2CR17	12-99	Diode		1N483B
A2CR18	12-99	Diode		1N483B
A2CR19	12-99	Diode		1N483B
A2CR20	12-99	Diode		1N483B
A2CR21	12-110	Diode		1N4383
A2CR22	12-110	Diode		1N4383
A2CR23	12-218	Diode, Constant Current		1N5305

TABLE 6-8. ASSEMBLY A2-431A (W.E.) VARACTOR TUNING AND BIAS SUPPLY
PARTS LIST (cont)

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A2CR24	12-99	Diode		1N483B
A2CR25	12-99	Diode		1N483B
A2CR26	12-99	Diode		1N483B
A2CR27	12-99	Diode		1N483B
A2CR28	12-99	Diode		1N483B
A2CR29	12-99	Diode		1N483B
A2CR30	12-99	Diode		1N483B
A2CR31	12-134	Diode, Zener		1N756B
A2CR32	12-99	Diode		1N483B
A2CR33		Not Used		
A2CR34		Not Used		
A2CR35	12-205	Diode, Constant Current		1N5297
A2CR36	12-205	Diode, Constant Current		1N5297
A2CR37	12-113	Diode, Zener		1N4764A
A2CR38	12-182	Diode, Zener		1N5252
A2CR39	12-182	Diode, Zener		1N5374A
A2CR40	12-99	Diode		1N483B
A2CR41	12-99	Diode		1N483B
A2CR43	12-99	Diode		1N483B
A2CR44	12-99	Diode		1N483B
A2CR45	12-99	Diode		1N483B
A2CR46	12-99	Diode		1N483B
A2CR47	12-99	Diode		1N483B
A2CR48	12-51	Diode		1N914B
A2CR49	12-51	Diode		1N914B
A2F1	52-1-1	Fuse	71400	AGC-1
A2F2	52-1-1/32	Fuse	71400	AGC-1/32
A2IC1	12-165	Amplifier Operational	27014	LM301AH
A2IC2	12-165	Amplifier Operational	27014	LM301AH
A2IC3	12-192	Amplifier Operational	04713	MC1458P
A2IC4	12-192	Amplifier Operational	04713	MC1458P
A2K1	47-30	Relay, Reed	70109	ARA1-13006L
A2Q1	12-140	Transistor		2N4403
A2Q2	12-139	Transistor		2N4401
A2Q3	12-222	Transistor		2N4045
A2Q4	12-255	Transistor	04713	MM4001
A2Q5	12-198	Transistor	04713	MM3001
A2Q6	12-198	Transistor	04713	MM3001
A2Q7	12-140	Transistor		2N4403
A2Q8	12-255	Transistor	04713	MM4001
A2Q9	12-255	Transistor	04713	MM4001
A2Q10	12-139	Transistor		2N4401
A2Q11	12-202	Transistor, FET		2N4092
A2Q12	12-140	Transistor		2N4403
A2Q13	12-255	Transistor	04713	MM4001

TABLE 6-8. ASSEMBLY A2-431A (W.E.) VARACTOR TUNING AND BIAS SUPPLY PARTS LIST (cont)

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A2Q14	12-139	Transistor		2N4401
A2Q15	12-140	Transistor		2N4403
A2Q16	12-194	Transistor	04713	MPSU55
A2Q17		Not Used		
A2Q18	12-140	Transistor		2N4403
A2Q19	12-140	Transistor		2N4403
A2R1	26-79-15	Res, 15 ohm, 5%, 3W		RW79U1500J
A2R2	25-8-2700	Res, 2.7K 5%, ½W		RC20GF272J
A2R3	25-20-23R7K	Res, 23.7K 1%, 1/8W		RN60C2372F
A2R4	25-25-	Res, 5%, ¼W, (Selected at Test)		RC07
A2R5	25-25-2200	Res, 2.2K, 5%, ¼W		RC07GF222J
A2R6	25-25-220	Res, 220 ohm, 5%, ¼W		RC07GF221J
A2R7	25-8-470	Res, 470 ohm, 5%, ½W		RC20GF471J
A2R8	25-25-33	Res, 33 ohm, 5%, ¼W		RC07GF330J
A2R9	26-20-1	Res, 1.0 ohm,5%, 2W	06486	BWH
A2R10	25-25-180	Res, 180 ohm, 5%, ¼W		RC07GF181J
A2R11	25-25-15K	Res, 15K, 5%, ¼W		RC07GF153J
A2R12	25-25-470	Res, 470 ohm, 5%, ¼W		RC07GF471J
A2R13	25-25-22K	Res, 22K, 5%, ¼W		RC07GF223J
A2R14	25-20-1960	Res, 1.96K 1%, 1/8W		RN60C1961F
A2R15	20-186-2K	Res, Variable, 2K	73138	89P
A2R16	25-20-1960	Res, 1.96K 1%, 1/8W		RN60C1961F
A2R17	25-25-220	Res, 220 ohm, 5%, ¼W		RC07GF221J
A2R18	25-25-3300	Res, 3.3K, 5%, ¼W		RC07GF333J
A2R19	26-30-147	Res, 147 ohm, 1%, 3W		RW79U1470F
A2R20	26-30-147	Res, 147 ohm, 1% 3W		RW79U1470F
A2R21	25-25-1800	Res, 1.8K, 5%, ¼W		RC07GF182J
A2R22	25-25-20K	Res, 20K, 5%, ¼W		RC07GF203J
A2R23	25-20-12R1K	Res, 12.1K, 1%, 1/8W		RN60C1212F
A2R24	25-20-3920	Res, 3.92K, 1%, 1/8W		RN60C3921F
A2R25	25-20-33K	Res, 33K, 1%, 1/8W		RN60C3302F
A2R26	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R27	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R28	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R29	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R30	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R31	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R32	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R33	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R34	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R35	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R36	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R37	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R38	25-20-15K	Res, 15K, 1%, 1/8W		RN60C1502F

TABLE 6-8. ASSEMBLY A2-431A (W.E.) VARACTOR TUNING AND BIAS SUPPLY
PARTS LIST (cont)

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A2R39		Not Used		
A2R40		Not Used		
A2R41		Not Used		
A2R42	25-25-1000	Res, 1K, 5%, ¼W		RC07GF102J
A2R43	25-25-470	Res, 470 ohm, 5%, ¼W		RC07GF471J
A2R44	25-25-3900	Res, 3.9K, 5%, ¼W		RC07GF392J
A2R45	25-20-15K	Res, 15K, 1%, 1/8W		RN60C1502F
A2R46	20-184-	Res, Variable, 500 ohm	73138	89P
A2R47	25-20-100	Res, 100 ohm, 1%, 1/8W		RN60C1000F
A2R48		Not Used		
A2R49	26-30-300	Res, 300 ohm, 1%, 3W		RW79U3000F
A2R50	20-189-50	Res, Variable, 50 ohm	73138	89P
A2R51		Not Used		
A2R52	20-189-20	Res, Variable, 20 ohm	73138	89P
A2R53		Not Used		
A2R54	20-189-20	Res, Variable, 20 ohm	73138	89P
A2R55		Not Used		
A2R56	20-189-20	Res, Variable, 20 ohm	73138	89P
A2R57	20-189-20	Res, Variable, 20 ohm	73138	89P
A2R58	20-189-20	Res, Variable, 20 ohm	73138	89P
A2R59	20-189-10	Res, Variable, 10 ohm	73138	89P
A2R60	20-189-10	Res, Variable, 10 ohm	73138	89P
A2R61	20-189-10	Res, Variable, 10 ohm	73138	89P
A2R62	20-189-10	Res, Variable, 10 ohm	73138	89P
A2R63	20-189-50	Res, Variable, 50 ohm	73138	89P
A2R64	26-94-400	Res, 400 ohm, 1%, 3W		RW79U4000G
A2R65	25-20-330	Res, 330 ohm, 1%, 1/8W		RN60C3300F
A2R66	25-20-49R9K	Res, 49.9K, 1%, 1/8W		RN60C4992F
A2R67	25-20-464K	Res, 464K, 1%, 1/8W		RN60C4643F
A2R68	25-20-464K	Res, 464K, 1%, 1/8W		RN60C4643F
A2R69	25-25-1200	Res, 1.2K, 5%, ¼W		RC07GF122J
A2R70	25-25-22	Res, 22 ohm, 5%, ¼W		RC07GF220J
A2R71		Not Used		
A2R72	20-189-20K	Res, Variable, 20K	73138	89P
A2R73		Not Used		
A2R74	25-25-68K	Res, 68K, 5%, ¼W		RC07GF683J
A2R75	25-25-2K	Res, 2K, 5%, ¼W		RC07GF202J
A2R76	25-25-15K	Res, 15K, 5%, ¼W		RC07GF153J
A2R77		Not Used		
A2R78	20-189-20K	Res, Variable, 20K	73138	89P
A2R79	25-20-40R2K	Res, 40.2K, 1%, 1/8W		RN60C4022F
A2R80	25-20-6810	Res, 6.81K, 1%, 1/8W		RN60C6811F
A2R81	25-20-750K	Res, 750K, 1%, 1/8W		RN60C7503F
A2R82	25-20-60R4K	Res, 60.4K, 1%, 1/8W		RN60C6042F
A2R83	25-20-2940	Res, 2.94K, 1%, 1/8W		RN60C2941F

TABLE 6-8. ASSEMBLY A2-431A (W.E.) VARACTOR TUNING AND BIAS SUPPLY
PARTS LIST (cont)

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A2R84	20-189-20K	Res, Variable, 20K	73138	89P
A2R85	25-20-19R6K	Res, 19.6K, 1%, 1/8W		RN60C1962F
A2R86	25-25-3300	Res, 3.3K, 5%, ¼W		RC07GF332J
A2R87	25-25-100	Res, 100 ohm, 5%, ¼W		RC07GF101J
A2R88	25-25-47K	Res, 47K, 5%, ¼W		RC07GF473J
A2R89	25-20-69R8K	Res, 69.8, 1%, 1/8W		RN60C6982F
A2R90	25-25-10M	Res, 10M, 5%, ¼W		RC07GF106J
A2R91	25-25-20K	Res, 20K, 5%, ¼W		RC07GF203J
A2R92	25-25-120K	Res, 120K, 5%, ¼W		RC07GF124J
A2R93	25-25-47K	Res, 47K, 5%, ¼W		RC07GF473J
A2R94	25-25-68	Res, 68 ohm, 5%, ¼W		RC07GF680J
A2R95	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A2R96	25-8-39K	Res, 39K, 5%, ½W		RC20GF393J
A2R97	25-25-20K	Res, 20K, 5%, ¼W		RC07GF203J
A2R98	25-25-33K	Res, 33K, 5%, ¼W		RC07GF333J
A2R99	25-8-47K	Res, 47K, 5%, ½W		RC20GF473J
A2R100	25-25-3900	Res, 3.9K, 5%, ¼W		RC07GF392J
A2R101	25-25-220	Res, 220K, 5%, ¼W		RC07GF224J
A2R102	25-20-475K	Res, 475K, 1%, 1/8W		RN60C4753F
A2R103	25-25-20K	Res, 20K, 5%, ¼W		RC07GF203J
A2R104	25-25-6800	Res, 6.8K, 5%, ¼W		RC07GF682J
A2R105	25-25-2R2M	Res, 2.2M, 5%, ¼W		RC07GF225J
A2R106	25-25-22K	Res, 22K, 5%, ¼W		RC07GF223J
A2R107	25-25-4700	Res, 4.7K, 5%, ¼W		RC07GF472J
A2R108	25-20-475K	Res, 475K, 1%, 1/8W		RN60C4753F
A2R109	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A2R110	25-25-1800	Res, 1.8K, 5%, ¼W		RC07GF103J
A2R111	25-25-33K	Res, 33K, 5%, ¼W		RC07GF333J
A2TP1	62-153	Pin, Quick Disconnect	71279	460-2970-02-03-00
A2TP2	62-153	Pin, Quick Disconnect	71279	460-2970-02-03-00
A2TP3	62-153	Pin, Quick Disconnect	71279	460-2970-02-03-00
A2TP4	62-153	Pin, Quick Disconnect	71279	460-2970-02-03-00
A2TP5	62-153	Pin, Quick Disconnect	71279	460-2970-02-03-00
A2TP6	62-153	Pin, Quick Disconnect	71279	460-2970-02-03-00

TABLE 6-9. ASSEMBLY A2-433A (W.J.) VARACTOR TUNING AND BIAS SUPPLY PARTS LIST

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A2	C139-107-2	Circuit Board Assembly, Varactor Tuning and Bias Supply	93459	
A2C1	34-21-R0033	Cap, 0.0033 µf, 10%, 200V		CK06BX332K
A2C2	34-21-R047	Cap, 0.047 µf, 10%, 200V		CK05BX470K
A2C3	34-21-150	Cap, 150 pf, 10%, 200V		CK05BX151K
A2C4	31-80	Cap, 10 µf, 35V	31433	T362C106M035
A2C5	34-21-R01	Cap, 0.01 µf, 10%, 200V		CK06BX103K
A2C6	34-21-R01	Cap, 0.01 µf, 10%, 200V		CK06BX103K
A2C7	34-21-R01	Cap, 0.01 µf, 10%, 200V		CK06BX103K
A2C8	34-21-560	Cap, 560 pf, 10%, 200V		CK05BX561K
A2C9	34-22-R1	Cap, 0.1 µf, 10%, 200V		CK06BX104K
A2C10	34-22-R1	Cap, 0.1 µf, 10%, 200V		CK06BX104K
A2C11	34-21-1500	Cap, 1500 pf, 10%, 200V		CK05BX152K
A2C12	34-21-R01	Cap, 0.01 µf, 10%, 200V		CK06BX103K
A2C13	34-21-1500	Cap, 1500 pf, 10%, 200V		CK05BX152K
A2C14	34-21-82	Cap, 82 pf, 10%, 200V		CK05BX820K
A2C15	34-21-470	Cap, 470 pf, 10%, 200V		CK05BX471K
A2C16	34-23-2R2	Cap, 2.2 µf, 50V	01884	7C023225X0500F
A2C17	34-23-R47	Cap, 0.47 µf, 50V	01884	7C023471X0500E
A2C18	33-35-R22	Cap, 0.22 µf, 200V	84411	X663F
A2CR1	12-99	Diode		1N483B
A2CR2	12-99	Diode		1N483B
A2CR3	12-99	Diode		1N483B
A2CR4	12-215	SCR		2N4441
A2CR5	12-110	Diode		1N4383
A2CR6	12-204	Diode		1N750A
A2CR7	12-99	Diode		1N483B
A2CR8	12-99	Diode		1N483B
A2CR9	12-99	Diode		1N483B
A2CR10	12-99	Diode		1N483B
A2CR11	12-99	Diode		1N483B
A2CR12	12-99	Diode		1N483B
A2CR13	12-99	Diode		1N483B
A2CR14	12-99	Diode		1N483B
A2CR15	12-99	Diode		1N483B
A2CR16	12-99	Diode		1N483B
A2CR17	12-99	Diode		1N483B
A2CR18	12-99	Diode		1N483B
A2CR19	12-99	Diode		1N483B
A2CR20	12-99	Diode		1N483B
A2CR21	12-110	Diode		1N4383
A2CR22	12-110	Diode		1N4383
A2CR23	12-218	Diode		1N5305
A2CR24	12-99	Diode		1N483B
A2CR25	12-99	Diode		1N483B

TABLE 6-9. ASSEMBLY A2-433A (W.J.) VARACTOR TUNING AND BIAS SUPPLY
PARTS LIST (cont)

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A2CR26	12-99	Diode		1N483B
A2CR27	12-99	Diode		1N483B
A2CR28	12-99	Diode		1N483B
A2CR29	12-99	Diode		1N483B
A2CR30	12-99	Diode		1N483B
A2CR31	12-134	Diode, Zener		1N756A
A2CR32	12-99	Diode		1N483B
A2CR33	12-99	Diode		1N483B
A2CR34	12-134	Diode, Zener		1N756A
A2CR35	12-205	Diode, Constant Current		1N5297
A2CR36	12-205	Diode, Constant Current		1N5297
A2CR37	12-113	Diode, Zener		1N4764A
A2CR38	12-182	Diode, Zener		1N5252
A2CR39	12-197	Diode, Zener		1N5374A
A2CR40	12-99	Diode		1N483B
A2CR41	12-99	Diode		1N483B
A2CR42	12-99	Diode		1N483B
A2CR43	12-99	Diode		1N483B
A2CR44	12-99	Diode		1N483B
A2CR45	12-99	Diode		1N483B
A2CR46	12-99	Diode		1N483B
A2CR47	12-99	Diode		1N483B
A2CR48	12-51	Diode		1N914B
A2CR49	12-51	Diode		1N914B
A2F1	52-1-1	Fuse	71400	AGC-1
A2F2	52-1-1/32	Fuse	71400	AGC-1/32
A2IC1	12-165	Amplifier Operational	27014	LM301AH
A2IC2	12-165	Amplifier Operational	27014	LM301AH
A2IC3	12-192	Amplifier Operational	04713	MC1458P
A2IC4	12-192	Amplifier Operational	04713	MC1458P
A2K1	47-30	Relay, Reed	70109	ARA1-130062
A2Q1	12-139	Transistor		2N4401
A2Q2	12-139	Transistor		2N4401
A2Q3	12-222	Transistor		2N4045
A2Q4	12-255	Transistor	04713	MM4001
A2Q5	12-198	Transistor	04713	MM3001
A2Q6	12-198	Transistor	04713	MM3001
A2Q7	12-140	Transistor		2N4403
A2Q8	12-255	Transistor	04713	MM4001
A2Q9	12-255	Transistor	04713	MM4001
A2Q10	12-139	Transistor		2N4401
A2Q11	12-202	Transistor, FET		2N4092
A2Q12	12-140	Transistor		2N4403
A2Q13	12-255	Transistor	04713	MM4001
A2Q14	12-139	Transistor		2N4401
A2Q15	12-140	Transistor		2N4403

TABLE 6-9. ASSEMBLY A2-433A (W.J.) VARACTOR TUNING AND BIAS SUPPLY
PARTS LIST (cont)

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A2Q16	12-194	Transistor	04713	MPSU55
A2Q17		Not Used		
A2Q18	12-139	Transistor		2N4401
A2Q19	12-140	Transistor		2N4403
A2R1	26-79-15	Res, 15 ohm, 5%, 3W		RW79U1500J
A2R2	25-8-2700	Res, 2.7K, 5%, ½W		RC20GF272J
A2R3	25-20-23R7K	Res, 23.7K, 1%, 1/8W		RN60C2372F
A2R4	25-25-100	Res, 100 ohm, 5%, ¼W		RC07GF101J
A2R5	25-25-2200	Res, 2.2K, 5%, ¼W		RC07GF222J
A2R6	25-25-220	Res, 220 ohm, 5%, ¼W		Rc07GF221J
A2R7	25-8-470	Res, 470 ohm, 5%, ½W		RC20GF471J
A2R8	25-25-33	Res, 33 ohm, 5%, ¼W		RC07GF330J
A2R9	26-20-1	Res, 1.0 ohm, 5%, 2W		RN60C1960F
A2R10	25-25-180	Res, 180 ohm, 5%, ¼W		RC07GF181J
A2R11	25-25-15K	Res, 15K, ¼W		RC07GF153J
A2R12	25-25-470	Res, 470 ohm, 5%, ¼W		RC07GF471J
A2R13	25-25-22K	Res, 22K, 5%, ¼W		RC07GF223J
A2R14	25-20-1960	Res, 1.96K 1%, 1/8W		RN60C1960F
A2R15	20-183-2K	Res, Variable, 2K	73138	89P
A2R16	25-20-1960	Res, 1.96K, 1%, 1/8W		RN60C1961F
A2R17	25-25-220	Res, 220 ohm, 5%, ¼W		RC07GF221J
A2R18	25-25-3300	Res, 3.3K, 5%, ¼W		RC07GF332J
A2R19	26-30-147	Res, 147 ohm, 1%, 3W		RW79U1470F
A2R20	26-30-147	Res, 147 ohm, 1%, 3W		RW79U1470F
A2R21	25-25-1800	Res, 1.8K, 5%, ¼W		RC07GF182J
A2R22	25-25-20K	Res, 20K, 5%, ¼W		RC07GF203J
A2R23	25-20-1212	Res, 12.1K, 1%, 1/8W		RN60C1212F
A2R24	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R25	25-20-33K	Res, 33K, 1%, 1/8W		RN60C3302F
A2R26	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R27	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R28	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R29	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R30	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R31	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R32	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R33	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R34	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R35	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R36	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R37	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R38	25-20-15K	Res, 15K, 1%, 1/8W		RN60C1502F
A2R39		Not Used		
A2R40		Not Used		
A2R41		Not Used		

TABLE 6-9. ASSEMBLY A2-433A (W.J.) VARACTOR TUNING AND BIAS SUPPLY PARTS LIST (cont)

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A2R42	25-25-1000	Res, 1K, 5%, ¼W		RC07GF102J
A2R43	25-25-470	Res, 470 ohm, 5%, ¼W		RC07GF471J
A2R44	25-25-3900	Res, 3.9K, 5%, ¼W		RC07GF392J
A2R45	25-20-15K	Res, 15K, 1%, 1/8W		RN60C1502F
A2R46	20-184-500	Res, Variable, 500 ohm	73138	89P
A2R47	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R48	26-30-	Res, Select at Test, 1%, 3W		RW79U
A2R49	26-30-300	Res, 300 ohm, 1%, 3W		RW79U3000F
A2R50	20-189-50	Res, Variable, 50 ohm	73138	89P
A2R51	25-25-	Res, Select at Test 5%, ¼W		RC07
A2R52	20-189-20	Res, Variable, 20 ohm	73138	89P
A2R53	25-25-	Res, Select at Test, 5%, ¼W		RC07
A2R54	20-189-20	Res, Variable, 20 ohm	73138	89P
A2R55	25-25-	Res, Select at Test, 5%, ¼W		RC07
A2R56	20-189-20	Res, Variable, 10 ohm	73138	89P
A2R57	20-189-20	Res, Variable, 20 ohm	73138	89P
A2R58	20-189-20	Res, Variable, 20 ohm	73138	89P
A2R59	20-189-10	Res, Variable, 10 ohm	73138	89P
A2R60	20-189-10	Res, Variable, 10 ohm	73138	89P
A2R61	20-189-10	Res, Variable, 10 ohm	73138	89P
A2R62	20-189-10	Res, Variable, 10 ohm	73138	89P
A2R63	20-189-50	Res, Variable, 50 ohm	73138	89P
A2R64	26-94-	Res, Select at Test, 1%, 3W		RW79U
A2R65	25-20-330	Res, 330 ohm, 1%, 1/8W		RN60C3300F
A2R66	25-20-49R9K	Res, 49.9K, 1%, 1/8W		RN60C4992F
A2R67	25-20-464K	Res, 464K, 1%, 1/8W		RN60C4643F
A2R68	25-20-464K	Res, 464K, 1%, 1/8W		RN60C4643F
A2R69	25-25-1200	Res, 1.2K, 5%, ¼W		RC07GF122J
A2R70	25-25-22	Res, 22 ohm, 5%, ¼W		RC07GF220J
A2R71		Not Used		
A2R72	20-189-20K	Res, Variable, 20K	73138	89P
A2R73		Not Used		
A2R74	25-25-68K	Res, 68K,5%, ¼W		RC07GF683J
A2R75	25-25-2K	Res, 2K, 5%, ¼W		RC07GF202J
A2R76	25-25-15K	Res, 15K, 5%, ¼W		RC07GF153J
A2R77		Not Used		
A2R78	20-189-20K	Res, Variable, 20K	73138	89P
A2R79	25-20-40R2K	Res, 40.2K 1%, 1/8W		RN60C4022F
A2R80	25-20-6810	Res, 6.81K, 1%, 1/8W		RN60C6811F
A2R81	25-20-750K	Res, 750K, 1%, 1/8W		RN60C7503F
A2R82	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R83	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R84	20-189-20K	Res, Variable, 20K	73138	89P
A2R84	25-20-19R6K	Res, 19.6K, 1%, 1/8W		RN60C1962F
A2R85	25-25-3300	Res, 3.3K, 5%, ¼W		RC07GF332J
A2R86	25-25-3300	Res, 3.3K, 5%, ¼W		RC07GF332J

TABLE 6-9. ASSEMBLY A2-433A (W.J.) VARACTOR TUNING AND BIAS SUPPLY
PARTS LIST (cont)

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A2R87	25-25-100	Res, 100 ohm, 5%, ¼W		RC07GF101J
A2R88	25-25-47K	Res, 47K, 5%, ¼W		RC07GF473J
A2R89	25-20-69R8K	Res, 69.8K, 1%, 1/8W		RN60C6982F
A2R90	25-25-10M	Res, 10M, 5%, ¼W		RC07GF106J
A2R91	25-25-20K	Res, 20K, 5%, ¼W		RC07GF203J
A2R93	25-25-47K	Res, 47K, 5%, ¼W		RC07GF473J
A2R94	25-25-68	Res, 68 ohm, 5%, ¼W		RC07GF680J
A2R95	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A2R96	25-8-39K	Res, 39K, 5%, ½W		RC30GF393J
A2R97	25-25-20K	Res, 20K, 5%, ¼W		RC07GF203J
A2R98	25-25-33K	Res, 33K, 5%, ¼W		RC07GF333J
A2R99	25-8-47K	Res, 47K, 5%, ½W		RC20GF473J
A2R100	25-25-3900	Res, 3.9K, 5%, ¼W		RC07GF392J
A2R101	25-25-220	Res, 220 ohm, 5%, ¼W		RC07GF221J
A2R102	25-20-475K	Res, 475K, 1%, 1/8W		RN60C4753F
A2R103	25-25-20K	Res, 20K, 5%, ¼W		RC07GF203J
A2R104	25-25-6800	Res, 6.8K, 5%, ¼W		RC07GF682J
A2R105	25-25-2R2M	Res, 2.2M, 5%, ¼W		RC07GF225J
A2R106	25-25-22K	Res, 22K, 5%, ¼W		RC07GF223J
A2R107	25-25-4700	Res, 4.7K, 5%, ¼W		RC07GF472J
A2R108	25-20-475K	Res, 475K, 1%, 1/8W		RN60C4753F
A2R109	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A2R110	25-25-1800	Res, 1.8K, 5%, ¼W		RC07GF182J
A2R11	25-25-33K	Res, 33K, 5%, ¼W		RC07GF333J
A2TP1	62-153	Pin, Quick Disconnect	71279	460-2970-02-03-00
A2TP2	62-153	Pin, Quick Disconnect	71279	460-2970-02-03-00
A2TP3	62-153	Pin, Quick Disconnect	71279	460-2970-02-03-00
A2TP4	62-153	Pin, Quick Disconnect	71279	460-2970-02-03-00
A2TP5	62-153	Pin, Quick Disconnect	71279	460-2970-02-03-00
A2TP6	62-153	Pin, Quick Disconnect	71279	460-2970-02-03-00

TABLE 6-10. ASSEMBLY A2-438A-1 (W.E.) VARACTOR TUNING AND BIAS SUPPLY PARTS LIST

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A2	C-139-107-3	Circuit Board Assembly, Varactor Tuning and Bias Supply	93459	
A2C1	34-21-R0033	Cap, 0.0033 μf, 10%, 200V		CK06BX332K
A2C2	34-21-R047	Cap, 0.047 μf, 10%, 200V		CK05BX470K
A2C3	34-21-150	Cap, 150 pf, 10%, 200V		CK05BX151K
A2C4	31-80	Cap, 10 μf, 35V	31433	T362C106M035
A2C5	34-21-R01	Cap, 0.01 μf, 10%, 200V		CK06BX103K
A2C6	34-21-R01	Cap, 0.01 μf, 10%, 200V		CK06BX103K
A2C7	34-21-R01	Cap, 0.01 μf, 10%, 200V		CK06BX103K
A2C8	34-21-560	Cap, 560 pf, 10%, 200V		CK05BX561K
A2C9	34-21-R01	Cap, 0.01 μf, 10%, 200V		CK06BX103K
A2C10	34-21-R01	Cap, 0.01 μf, 10%, 200V		CK06BX103K
A2C11	34-21-1500	Cap, 1500 pf, 10%, 200V		CK05BX152K
A2C12	34-21-R01	Cap, 0.01 μf, 10%, 200V		CK06BX103K
A2C13	34-21-1500	Cap, 1500 pf, 10%, 200V		CK05BX152K
A2C14	34-21-82	Cap, 82 pf, 10%, 200V		CK05BX820K
A2C15	34-21-470	Cap, 470 pf, 10%, 200V		CK05BX471K
A2C16	34-23-2R2	Cap, 2.2 μf, 50V	01884	7C023225X0500F
A2C17	34-23-R47	Cap, 0.47 μf, 50V	01884	7C023471X0500E
A2C18	33-35-R22	Cap, 0.22 μf, 200V	84411	X663F
A2C19	34-21-R01	Cap, 0.01 μf, 10%, 200V		CK06BX103K
A2CR1	12-99	Diode		1N483B
A2CR2	12-99	Diode		1N483B
A2CR3	12-99	Diode		1N483B
A2CR4	12-215	SCR		2N4441
A2CR5	12-110	Diode		1N4383
A2CR6	12-204	Diode		1N750A
A2CR7	12-99	Diode		1N483B
A2CR8	12-99	Diode		1N483B
A2CR9	12-99	Diode		1N483B
A2CR10	12-99	Diode		1N483B
A2CR11	12-99	Diode		1N483B
A2CR12	12-99	Diode		1N483B
A2CR13	12-99	Diode		1N483B
A2CR14	12-99	Diode		1N483B
A2CR15	12-99	Diode		1N483B
A2CR16	12-99	Diode		1N483B
A2CR17	12-99	Diode		1N483B
A2CR18	12-99	Diode		1N483B
A2CR19	12-99	Diode		1N483B
A2CR20	12-99	Diode		1N483B
A2CR21	12-110	Diode		1N4383
A2CR22	12-110	Diode		1N4383
A2CR23	12-218	Diode, Constant Current		1N5305
A2CR24	12-99	Diode		1N483B
A2CR25	12-99	Diode		1N483B
A2CR26	12-99	Diode		1N483B
A2CR27	12-99	Diode		1N483B

TABLE 6-10. ASSEMBLY A2-438A-1 (W.E.) VARACTOR TUNING AND BIAS SUPPLY
PARTS LIST (cont)

REFERENCE DESIGNATION	# PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A2CR28	12-99	Diode		1N438B
A2CR29	12-99	Diode		1N438B
A2CR30	12-99	Diode		1N438B
A2CR31	12-134	Diode, Zener		1N756A
A2CR32	12-99	Diode		1N483B
A2CR33		Not Used		
A2CR34		Not Used		
A2CR35	12-205	Diode, Constant Current		1N5297
A2CR36	12-205	Diode, Constant Current		1N5297
A2CR37	12-113	Diode, Zener		1N4764A
A2CR38	12-182	Diode, Zener		1N5252
A2CR39	12-197	Diode, Zener		1N5374A
A2CR40	12-99	Diode		1N483B
A2CR41	12-99	Diode		1N483B
A2CR42	12-99	Diode		1N483B
A2CR43	12-99	Diode		1N483B
A2CR44	12-99	Diode		1N483B
A2CR45	12-99	Diode		1N483B
A2CR46	12-99	Diode		1N483B
A2CR47	12-99	Diode		1N483B
A2CR48	12-51	Diode		1N914B
A2CR49	12-51	Diode		1N914B
A2F1	52-1-1		71400	AGC-1
A2F2	52-1-1/32		71400	AGC-1/32
A2IC1	12-165	Amplifier Operational	27014	LM301AH
A2IC2	12-165	Amplifier Operational	27014	LM301AH
A2IC3	12-192	Amplifier Operational	04713	MC1458P
A2IC4	12-192	Amplifier Operational	04713	MC1458P
A2K1	47-30	Relay, Reed	70109	ARA1-130062
A2Q1	12-140	Transistor		2N4403
A2Q2	12-139	Transistor		2N4401
A2Q3	12-222	Transistor		2N4045
A2Q4	12-255	Transistor	04713	MM4001
A2Q5	12-198	Transistor	04713	MM3001
A2Q6	12-198	Transistor	04713	MM3001
A2Q7	12-140	Transistor		2N4403
A2Q8	12-255	Transistor	04713	MM4001
A2Q9	12-255	Transistor	04713	MM4001
A2Q10	12-139	Transistor		2N4401
A2Q11	12-202	Transistor, FET		2N4092
A2Q12	12-140	Transistor		2N4403
A2Q13	12-255	Transistor	04713	MM4001
A2Q14	12-139	Transistor		2N4401
A2Q15	12-140	Transistor		2N4403
A2Q16	12-194	Transistor	04713	MPSU55
A2Q17		Not Used		
A2Q18	12-140	Transistor		2N4403
A2Q19	12-140	Transistor		2N4403

TABLE 6-10. ASSEMBLY A2-438A-1 (W.E.) VARACTOR TUNING AND BIAS SUPPLY
PARTS LIST (cont)

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A2R1	26-79-15	Res, 15 ohm, 5%, 3W		RW79U1500J
A2R2	25-8-2700	Res, 2.7 5%, ½W		RC20GF272J
A2R3	25-20-23R7K	Res, 23.7K, 1%, 1/8W		RN60C2372F
A2R4	25-25-	Res, Select at Test, 5%, ¼W		RC07
A2R5	25-25-2200	Res, 2.2K, 5%, ¼W		RC07GF222J
A2R6	25-25-220	Res, 220 ohm, 5%, ¼W		RC07GF221J
A2R7	25-8-470	Res, 470 ohm, 5%, ½W		RC20GF471J
A2R8	25-25-33	Res, 33 ohm, 5%, ¼W		RC07GF330J
A2R9	26-20-1	Res, 1.0 ohm, 5%, ¼W	06486	BWH
A2R10	25-25-180	Res, 180 ohm, 5%, ¼W		RC07GF181J
A2R11	25-25-15K	Res, 15K, 5%, ¼W		RC07GF153J
A2R12	25-25-470	Res, 470 ohm, 5%, ¼W		RC07GF471J
A2R13	25-25-22K	Res, 22K, 5%, ¼W		RC07GF223J
A2R14	25-20-1960	Res, 1.96K, 1%, 1/8W		RN60C1960F
A2R15	20-186-2K	Res, Variable, 2K	73138	89P
A2R16	25-20-1960	Res, 1.96K, 1%, 1/8W		RN60C1960F
A2R17	25-25-220	Res, 220 ohm, 5%, ¼W		RC07GF221J
A2R18	25-25-3300	Res, 3.3K, 5%, ¼W		RC07GF332J
A2R19	26-30-147	Res, 147 ohm, 1%, 3W		RW79U1470F
A2R20	26-30-147	Res, 147 ohm, 1%, 3W		RW79U1470F
A2R21	25-25-1800	Res, 1.8K, 5%, ¼W		RC07GF182J
A2R22	25-25-20K	Res, 20K, 5%, ¼W		RC07GF203J
A2R23	25-20-12R1K	Res, 12.1K, 1%, 1/8W		RN60C1212F
A2R24	25-20-3920	Res, 3.92K, 1%, 1/8W		RN60C3921F
A2R25	25-20-33K	Res, 33K, 1%, 1/8W		RN60C3302F
A2R26	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R27	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R28	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R29	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R30	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R31	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R32	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R33	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R34	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R35	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R36	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R37	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A2R38	25-20-15K	Res, 15K, 1%, 1/8W		RN60C1502F
A2R39		Not Used		
A2R40		Not Used		
A2R41		Not Used		
A2R42	25-25-1000	Res, 1K, 5%, ¼W		RC07GF102J
A2R43	25-25-470	Res, 470 ohm, 5%, ¼W		RC07GF471J
A2R44	25-25-3900	Res, 3.9K, 5%, ¼W		RC07GF392J
A2R45	25-20-15K	Res, 15K, 1%, 1/8W		RN60C1502F
A2R46	20-184-500	Res, Variable, 500 ohm	73138	89P
A2R47	25-20-100	Res, 100 ohm, 1%, 1/8W		RN60C1000F

TABLE 6-10. ASSEMBLY A2-438A-1 (W.E.) VARACTOR TUNING AND BIAS SUPPLY
PARTS LIST (cont)

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A2R48		Not Used		
A2R49	26-30-300	Res, 300 ohm, 1%, 3W		RW79U3000F
A2R50	20-189-50	Res, Variable, 50 ohm	73138	89P
A2R51		Not Used		
A2R52	20-189-20	Res, Variable, 20 ohm	73138	89P
A2R53		Not Used		
A2R54	20-189-20	Res, Variable, 20 ohm	73138	89P
A2R55		Not Used		
A2R56	20-189-20	Res, Variable, 20 ohm	73138	89P
A2R57	20-189-20	Res, Variable, 20 ohm	73138	89P
A2R58	20-189-20	Res, Variable, 20 ohm	73138	89P
A2R59	20-189-10	Res, Variable, 10 ohm	73138	89P
A2R60	20-189-10	Res, Variable, 10 ohm	73138	89P
A2R61	20-189-10	Res, Variable, 10 ohm	73138	89P
A2R62	20-189-10	Res, Variable, 10 ohm	73138	89P
A2R63	20-189-50	Res, Variable, 50 ohm	73138	89P
A2R64	26-94-400	Res, 400 ohm, 1%, 3W		RW79U4000F
A2R65	25-20-330	Res, 330 ohm, 1%, 1/8W		RN60C3300F
A2R66	25-20-49R9K	Res, 49.9K, 1%, 1/8W		RN60C4992F
A2R67	25-20-464K	Res, 464K, 1%, 1/8W		RN60C4643F
A2R68	25-20-464K	Res, 464K, 1%, 1/8W		RN60C4643F
A2R69	25-25-1200	Res, 1.2K, 5%, ¼W		RC07GF122J
A2R70	25-25-22	Res, 22 ohm, 5%, ¼W		RC07GF220J
A2R71	25-20-26R7K	Res, 26.7K, 1%, 1/8W		RN60C2672F
A2R72	20-189-20K	Res, Variable, 20K	73138	89P
A2R73	25-20-40R2K	Res, 40.2K, 1%, 1/8W		RN60C4022F
A2R74	25-25-68K	Res, 68K, 5%, ¼W		RC07GF683J
A2R75	25-25-2K	Res, 2K, 5%, ¼W		RC07GF202J
A2R76	25-25-15K	Res, 15K, 5%, ¼W		RC07GF153J
A2R77	25-20-4990	Res, 4.99K, 1%, 1/8W		RN60C4991F
A2R78	20-189-20K	Res, Variable, 20K	73138	89P
A2R79	25-20-40R2K	Res, 40.2K, 1%, 1/8W		RN60C4022F
A2R80	25-20-6810	Res, 6.81K, 1%, 1/8W		RN60C6811F
A2R81	25-20-750K	Res, 750K, 1%, 1/8W		RN60C7503F
A2R82	25-20-60R4K	Res, 60.4K, 1%, 1/8W		RN60C6042F
A2R83	25-20-2940	Res, 2.94K, 1%, 1/8W		RN60C2941F
A2R84	20-189-20K	Res, Variable, 20K	73138	89P
A2R85	25-20-19R6K	Res, 19.6K, 1%, 1/8W		RN60C1962F
A2R86	25-25-3300	Res, 3.3K, 5%, ¼W		RC07GF332J
A2R87	25-25-100	Res, 100 ohm, 5%, ¼W		RC07GF101J
A2R88	25-25-47K	Res, 47K, 5%, ¼W		RC07GF473J
A2R89	25-20-69R8K	Res, 69.8K, 1%, 1/8W		RN60C6982F
A2R90	25-25-10M	Res, 10M, 5%, ¼W		RC07GF106J
A2R91	25-25-20K	Res, 20K, 5%, ¼W		RC07GF203J
A2R92	25-25-120K	Res, 120K, 5%, ¼W		RC07GF124J
A2R93	25-25-47K	Res, 47K, 5%, ¼W		RC07GF473J

TABLE 6-10. ASSEMBLY A2-438A-1 (W.E.) VARACTOR TUNING AND BIAS SUPPLY
PARTS LIST (cont)

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A2R94	25-25-68	Res, 68 ohm, 5%, ¼W		RC07GF680J
A2R95	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A2R96	25-8-39K	Res, 39K, 5%, ½W		RC20GF393J
A2R94	25-25-20K	Res, 20K, 5%, ¼W		RC07GF203J
A2R98	25-25-33K	Res, 33K, 5%, ¼W		RC07GF333J
A2R99	25-8-47K	Res, 47K, 5%, ½W		RC20GF473J
A2R100	25-25-3900	Res, 3.9K, 5%, ¼W		RC07GF392J
A2R101	25-25-220	Res, 220 ohm, 5%, ¼W		RC07GF221J
A2R102	25-20-475K	Res, 475K, 1%, 1/8W		RN60C4753F
A2R103	25-25-20K	Res, 20K, 5%, ¼W		RC07GF203J
A2R104	25-25-6800	Res, 6.8K, 5%, ¼W		RC07GF682J
A2R105	25-25-2R2M	Res, 2.2M, 5%, ¼W		RC07GF225J
A2R106	25-25-22K	Res, 22K, 5%, ¼W		RC07GF223J
A2R107	25-25-4700	Res, 4.7K, 5%, ¼W		RC07GF472J
A2R108	25-20-475K	Res, 475K, 1%, 1/8W		RN60C4753F
A2R109	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A2R110	25-25-1800	Res, 1.8K, 5%, ¼W		RC07GF182J
A2R111	25-25-33K	Res, 33K, 5%, ¼W		RC07GF333J
A2TP1	62-153	Pin, Quick Disconnect	71279	460-2970-02-03-00
A2TP2	62-153	Pin, Quick Disconnect	71279	460-2970-02-02-00
A2TP3	62-153	Pin, Quick Disconnect	71279	460-2970-02-03-00
A2TP4	62-153	Pin, Quick Disconnect	71279	460-2970-02-03-00
A2TP5	62-153	Pin, Quick Disconnect	71279	460-2970-02-03-00
A2TP6	62-153	Pin, Quick Disconnect	71279	460-2970-02-03-00

TABLE 6-11. ASSEMBLY A3, AUXILIARY BOARD PARTS LIST

REFERENCE DESIGNATION	# PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A3	B139-111	Printed Circuit Assembly Auxiliary Reference Supply	93459	
A3C1	34-22-R1	Cap, 0.1 μf, 10%, 100V		CK06BX104K
A3C2	34-21-10	Cap, 10 pf, 10%, 200V		CK05BX100K
A3C3	34-21-R01	Cap, 0.01 μf, 10%, 100V		CK06BX103K
A3CR1	12-51	Diode		1N914B
A3CR2	12-51	Diode		1N914B
A3R1	25-25-820	Res, 820 ohm, 5%, ¼W		RC07GF821J
A3R2	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A3R3	25-25-1000	Res, 1K, 5%, ¼W		RC07GF102J
A3R4	25-25-390	Res, 390 ohm, 5%, ¼W		RC07GF391J
A3R5	25-25-3600	Res, 3.6K, 5%, ¼W		RC07GF362J
A3R6	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A3R7	25-25-4700	Res, 4.7K, 5%, ¼W		RC07GF472J
A3R8	25-25-5100	Res, 5.1K, 5%, ¼W		RC07GF512J
A3R9	25-25-12K	Res, 12K, 5%, ¼W		RC07GF123J
A3R10	25-25-2700	Res, 2.7K, 5%, ¼W		RC07GF272J
A3R11	25-25-1000	Res, 1K, 5%, ¼W		RC07GF102J
A3R12	25-25-560	Res, 560 ohm, 5%, ¼W		RC07GF561J
A3R13	25-25-560	Res, 560 ohm, 5%, ¼W		RC07GF561J
A3R14	25-25-1000	Res, 1K, 5%, ¼W		RC07GF102J
A3R15	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A3Q1	12-140	Transistor		2N4403
A3Q2	12-140	Transistor		2N4403
A3Q3	12-139	Transistor		2N4401
A3Q4	12-139	Transistor		2N4401
A3Q5	12-139	Transistor		2N4401
A3Q6	12-140	Transistor		2N4403
A3Q7	12-140	Transistor		2N4403

TABLE 6-12. ASSEMBLY A4, (431A, 438A) SYMMETRICAL SWEEP SWITCH PARTS LIST

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A4	B139-199	Assembly, Sym. Sweep Switch	93459	
A4C1	34-21-R0022	Cap, 2200 pf, 10%, 110V		CK06BX222K
A4R1	P/O S1			
A4R2	25-20-6980	Res, 6980 ohm, 1%, 1/8W		RN60C6981F
A4R3	25-20-3480	Res, 3480 ohm, 1%, 1/8W		RN60C3481F
A4R4	25-20-1400	Res, 1400 ohm, 1%, 1/8W		RN60C1401F
A4R5	25-20-698	Res, 698 ohm, 1%, 1/8W		RN60C6980F
A4R6	25-20-348	Res, 348 ohm, 1%, 1/8W		RN60C3480F
A4R7	25-20-140	Res, 140 ohm, 1%, 1/8W		RN60C1400F
A4R8	25-20-69R8	Res, 69.8 ohm, 1%, 1/8W		RN60C69R8F
A4R9	25-20-34R8	Res, 34.8 ohm, 1%, 1/8W		RN60C34R8F
A4R10	25-20-14	Res, 14.0 ohm, 1%, 1/8W		RN60C14R0F
A4R11		Not Used		
A4R12	25-25-47K	Res, 47K, 5%, ¼W		RC07GF473J
A4S1	B56-72	Switch, rotary/pot	93459	

TABLE 6-13. ASSEMBLY A4, (432A, 433A) SYMMETRICAL SWEEP SWITCH PARTS LIST

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A4	B139-200	Assembly, Sym. Sweep Switch	93459	
A4C1	34-21-R0022	Cap, 2200 pf, 10%, 100V		CK06BX222K
A4R1	P/O S1			
A4R2	25-20-6980	Res, 6980 ohm, 1%, 1/8W		RN60C6981F
A4R3	25-20-3480	Res, 3480 ohm, 1%, 1/8W		RN60C3481F
A4R4	25-20-1740	Res, 1740 ohm, 1%, 1/8W		RN60C1741F
A4R5	25-20-698	Res, 698 ohm, 1%, 1/8W		RN60C6980F
A4R6	25-20-348	Res, 348 ohm, 1%, 1/8W		RN60C3480F
A4R7	25-20-174	Res, 174 ohm, 1%, 1/8W		RN60C1740F
A4R8	25-20-69R8	Res, 69.8 ohm, 1%, 1/8W		RN60C69R8F
A4R9	25-20-34R8	Res, 34.8 ohm, 1%, 1/8W		RN60C34R8F
A4R10	25-20-17R4	Res, 17.4 ohm, 1%, 1/8W		RN60C17R4F
A4R11		Not Used		
A4R12	25-25-47K	Res, 47K, 5%, ¼W		RC07GF473J

TABLE 6-14. ASSEMBLY A4, (434A) SYMMETRICAL SWEEP SWITCH PARTS LIST

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A4	B139-201	Assembly, Sym. Sweep Switch	93459	
A4C1	34-21-R0022	Cap, 2200 pf, 10%, 100V		CK06BX222K
A4R1	P/O S1			
A4R2	25-20-6340	Res, 6340 ohm, 1%, 1/8W		RN60C6341F
A4R3	25-20-3160	Res, 3160 ohm, 1%, 1/8W		RN60C3161F
A4R4	25-20-1580	Res, 1580 ohm, 1%, 1/8W		RN60C1581F
A4R5	25-20-634	Res, 634 ohm, 1%, 1/8W		RN60C340F
A4R6	25-20-316	Res, 316 ohm, 1%, 1/8W		RN60C3160F
A4R7	25-20-158	Res, 158 ohm, 1%, 1/8W		RN60C1580F
A4R8	25-20-63R4	Res, 63.4 ohm, 1%, 1/8W		RN60C63R4F
A4R9	25-20-31R6	Res, 31.6 ohm, 1%, 1/8W		RN60C31R6F
A4R10	25-20-15R8	Res, 15.8 ohm, 1%, 1/8W		RN60C15R8F
A4R11		Not Used		
A4R12	25-25-47K	Res, 47K, 5%, ¼W		RC07GF473J
A4S1	B56-72	Switch, rotary/pot	93459	

TABLE 6-15. ASSEMBLY A4, (435A) SYMMETRICAL SWEEP SWITCH PARTS LIST

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A4	B139-202	Assembly, Sym. Sweep Switch	93459	
A4C1	34-21-R0022	Cap, 2200 pf, 10%, 100V		CK06BX222K
A4R1	P/O S1			
A4R2	25-20-6190	Res, 6190 ohm, 1%, 1/8W		RN60C6191F
A4R3	25-20-2490	Res, 2490 ohm, 1%, 1/8W		RN60C2491F
A4R4	25-20-1270	Res, 1270 ohm, 1%, 1/8W		RN60C1271F
A4R5	25-20-619	Res, 619 ohm, 1%, 1/8W		RN60C6190F
A4R6	25-20-249	Res, 249 ohm, 1%, 1/8W		RN60C2490F
A4R7	25-20-127	Res, 127 ohm, 1%, 1/8W		RN60C1270F
A4R8	25-20-61R9	Res, 61.9 ohm, 1%, 1/8W		RN60C61R9F
A4R9	25-20-24R9	Res, 24.9 ohm, 1%, 1/8W		RN60C24R9F
A4R10	25-20-12R7	Res, 12.7 ohm, 1%, 1/8W		RN60C12R7F
A4R11		Not Used		
A4R12	25-25-47K	Res, 47K, 5%, ¼W		RC07GF473J
A4S1	B56-72	Switch, rotary/pot	93459	

TABLE 6-16. ASSEMBLY A4, (442A) SYMMETRICAL SWEEP SWITCH PARTS LIST

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A4	B139-275	Assembly, Sym. Sweep Switch	93459	
A4C1	34-21-R0022	Cap, 2200 pf, 10%, 100V		CK06BX222K
A4R1	P/O S1			
A4R2	25-20-6980	Res, 6980 ohm, 1%, 1/8W		RN60C6981F
A4R3	25-20-2800	Res, 2800 ohm, 1%, 1/8W		RN60C2801F
A4R4	25-20-1400	Res, 1400 ohm, 1%, 1/8W		RN60C1401F
A4R5	25-20-698	Res, 698 ohm, 1%, 1/8W		RN60C6980F
A4R6	25-20-280	Res, 280 ohm, 1%, 1/8W		RN60C2800F
A4R7	25-20-140	Res, 140 ohm, 1%, 1/8W		RN60C1400F
A4R8	25-20-69R8	Res, 69.8 ohm, 1%, 1/8W		RN60C69R8F
A4R9	25-20-28R0	Res, 28.0 ohm, 1%, 1/8W		RN60C28R0F
A4R10	25-20-14R0	Res, 14.0 ohm, 1%, 1/8W		RN60C14R0F
A4R11		Not Used		
A4R12	25-25-47K	Res, 47K, 5%, ¼W		RC07GF473J
A4S1	B56-72	Switch, rotary/pot	93459	

TABLE 6-17. ASSEMBLY A11, (434A) HEAT EXCHANGER PARTS LIST

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A11	B139-316-1	Assembly, Heat Exchanger	93459	
A11CR1	12-71	Diode		1N753
A11Q1	12-140	Transistor		2N4403
A11Q2	12-186	Transistor	04713	MJE1102
A11R1	25-25-6R8K	Res, 6.8K, 5%, ¼W		RC07GF682J
A11R2	25-25-6R8K	Res, 6.8K, 5%, ¼W		RC07GF682J
A11R3	25-25-1K	Res, 1K, 5%, ¼W		RC07GF102J
A11R4	25-25-1K	Res, 1K, 5%, ¼W		RC07GF102J
A11R5	26-79-20	Res, 20 ohm, 3W	01884	242E2005

TABLE 6-18. ASSEMBLY A11, (435A) HEAT EXCHANGER PARTS LIST

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A11	B139-316-2	Assembly, Heat Exchanger	93459	
A11CR1	12-71	Diode		1N753
A11Q1	12-140	Transistor		2N4403
A11Q2	12-186	Transistor	04713	MJE1102
A11R1	25-25-6R8K	Res, 6.8K, 5%, ¼W		RC07GF682J
A11R2	25-25-6R8K	Res, 6.8K, 5%, ¼W		RC07GF682J
A11R3	25-25-1K	Res, 1K, 5%, ¼W		RC07GF102J
A11R4	25-25-1K	Res, 1K, 5%, ¼W		RC07GF102J
A11R5	26-79-10	Res, 10 ohm, 3W	01884	242E-1005

TABLE 6-19. ASSEMBLY A5-438A-1 (W.E.) CONTROL LOGIC PARTS LIST

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A5	C139-297	Circuit Board Assembly Control Logic	93459	
A5C1	34-21-R0022	Cap, 2200 pf, 10%, 100V		CK06BX222K
A5C2	34-21-150	Cap, 150 pf		CK05BX151K
A5C3	34-22-R1	Cap, 0.1 μf, 10%, 50V		CK06BX104K
A5C4	34-22-R01	Cap, 0.01 μf, 10%, 100V		CK06BX103K
A5C5	34-21-R001	Cap, 0.001 μf, 10%, 200V		CK05BX102K
A5C6	34-21-R0022	Cap, 2200 pf, 10%, 100V		CK06BX222K
A5C7	34-21-100	Cap, 100 pf, 10%, 200V		CK05BX101K
A5C8	34-21-56	Cap, 56 pf, 10%, 200V		CK05BX560K
A5C9	34-22-R1	Cap, 0.1 μf, 10%, 50V		CK06BX104K
A5C10	34-21-R0022	Cap, 2200 pf, 10%, 100V		CK06BX222K
A5C11	34-22-R1	Cap, 0.1 μf, 10%, 50V		CK06BX104K
A5C12	34-22-R1	Cap, 0.1 μf, 10%, 50V		CK06BX104K
A5C13	34-22-R1	Cap, 0.1 μf, 10%, 50V		CK06BX104K
A4C14	34-21-22	Cap, 22 pf, 10%, 200V		CK05BX220K
A5CR1	12-51	Diode		1N914B
A5CR2	12-51	Diode		1N914B
A5CR3	12-51	Diode		1N914B
A5CR4	12-51	Diode		1N914B
A5CR5	12-51	Diode		1N914B
A5CR6	12-51	Diode		1N914B
A5CR7	12-51	Diode		1N914B
A5CR8	12-51	Diode		1N914B
A5CR9	12-51	Diode		1N914B
A5CR10	12-51	Diode		1N914B
A5CR11	12-51	Diode		1N914B
A5CR12	12-51	Diode		1N914B
A5CR13	12-51	Diode		1N914B
A5CR14	12-51	Diode		1N914B
A5CR15	12-51	Diode		1N914B
A5CR16	12-51	Diode		1N914B
A5IC1	12-170	Circuit Integrated	04713	MC830P
A5IC2	12-165	Amplifier, Operational	27014	LM301AH
A5IC3	12-192	Circuit Integrated	04713	MC1458P
A5IC4	12-165	Amplifier, Operational	27014	LM301AH
A5IC5	12-250	Circuit Integrated	02735	CD4016AE
A5IC6	12-250	Circuit Integrated	02735	CD4016AE
A5IC7	12-172	Circuit Integrated	02735	CA3046
A5K1	47-29	Relay, Reed	12300	JRM1049
A5Q1	12-140	Transistor		2N4403
A5Q2	12-139	Transistor		2N4401
A5Q3	12-139	Transistor		2N4401
A5Q4	12-140	Transistor		2N4403
A5Q5	12-139	Transistor		2N4401

TABLE 6-19. ASSEMBLY A5-438A-1 (W.E.) CONTROL LOGIC
PARTS LIST (cont)

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A5Q6	12-139	Transistor		2N4401
A5Q7	12-140	Transistor		2N4403
A5Q8	12-140	Transistor		2N4403
A5Q9	12-139	Transistor		2N4401
A5Q10	12-139	Transistor		2N4401
A5Q11	12-140	Transistor		2N4403
A5Q12	12-140	Transistor		2N4403
A5Q13	12-139	Transistor		2N4401
A5Q14	12-140	Transistor		2N4403
A5Q15	12-139	Transistor		2N4401
A5Q16	12-140	Transistor		2N4403
A5Q17	12-140	Transistor		2N4403
A5Q18	12-140	Transistor		2N4403
A5Q19	12-139	Transistor		2N4401
A5Q20	12-140	Transistor		2N4403
A5Q21	12-140	Transistor		2N4403
A5Q22	12-140	Transistor		2N4403
A5Q23	12-139	Transistor		2N4401
A5Q24	12-140	Transistor		2N4403
A5Q25	12-139	Transistor		2N4401
A5Q26	12-139	Transistor		2N4401
A5Q27	12-139	Transistor		2N4401
A5Q28	12-140	Transistor		2N4403
A5Q29	12-139	Transistor		2N4401
A5Q30	12-140	Transistor		2N4403
A5Q31	12-139	Transistor		2N4401
A5Q32	12-139	Transistor		2N4401
A5Q33	12-139	Transistor		2N4401
A5Q34	12-139	Transistor		2N4401
A5Q35	12-140	Transistor		2N4403
A5Q36	12-139	Transistor		2N4401
A5Q37	12-140	Transistor		2N4403
A5Q38	12-139	Transistor		2N4401
A5Q39	12-140	Transistor		2N4403
A5Q40	12-140	Transistor		2N4403
A5Q41	12-140	Transistor		2N4403
A5R1	25-20-10K	Res, 10K, 1%, 1/8W		RN60C1002F
A5R2	25-20-10K	Res, 10K, 1%, 1/8W		RN60C1002F
A5R3	20-194-1K	Res, Variable, 1K	73138	89P
A5R4	25-20-10K	Res, 10K, 1%, 1/8W		RN60C1002F
A5R5	25-25-3300	Res, 3.3K, 5%, ¼W		RC07GF332J
A5R6	25-25-33K	Res, 33K, 5%, ¼W		RC07GF333J
A5R7	25-25-4700	Res, 4.7K, 5%, ¼W		RC07GF472J
A5R8	25-25-68	Res, 68 ohm, 5%, ¼W		RC07GF680J
A5R9	25-20-10K	Res, 10K, 1%, 1/8W		RN60C1002F

TABLE 6-19. ASSEMBLY A5-438A-1 (W.E.) CONTROL LOGIC
PARTS LIST (cont)

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A5R10	25-25-1500	Res, 1.5K, 5%, ¼W		RC07GF152J
A5R11	25-25-6800	Res, 6.8K, 5%, ¼W		RC07GF682J
A5R12	25-25-6800	Res, 6.8K, 5%, ¼W		RC07GF682J
A5R13	25-25-6800	Res, 6.8K, 5%, ¼W		RC07GF682J
A5R14	25-25-4700	Res, 4.7K, 5%, ¼W		RC07GF472J
A5R15	25-25-15K	Res, 15K, 5%, ¼W		RC07GF153J
A5R16	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R17	25-25-4700	Res, 4.7K, 5%, ¼W		RC07GF472J
A5R18	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R19	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R20	25-25-4700	Res, 4.7K, 5%, ¼W		RC07GF472J
A5R21	25-25-150	Res, 150 ohm, 5%, ¼W		RC07GF151J
A5R22	25-25-4700	Res, 4.7K, 5%, ¼W		RC07GF472J
A5R23	25-25-150	Res, 150 ohm, 5%, ¼W		RC07GF151J
A5R24	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R25	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R26	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R27	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R28	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R29	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R30	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A5R31	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A5R32	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A5R33	25-20-	Res, Select at Test, 1%, 1/8W		RN60C
A5R34	25-25-4700	Res, 4.7K, 5%, ¼W		RC07GF472J
A5R35	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R36	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R37	25-25-47K	Res, 48K, 5%, ¼W		RC07GF483J
A5R38	25-25-1000	Res, 1K, 5%, ¼W		RC07GF102J
A5R39	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R40	25-25-2200	Res, 2.2K, 5%, ¼W		RC07GF222J
A5R41	25-25-2200	Res, 2.2K, 5%, ¼W		RC07GF222J
A5R42	20-194-500	Res, Variable, 500 ohm	73138	89P
A5R43	25-20-15K	Res, 15K, 1%, 1/8W		RN60C1502F
A5R44	25-20-10K	Res, 10K, 1%, 1/8W		RN60C1002F
A5R45	26-95-10K	Res, 10K, 0.05%, 0.3W	18612	Style V53-1
A5R46	26-95-20K	Res, 20K, 0.05%, 0.3W	18612	Style V53-1
A5R47	20-194-2K	Res, Variable, 2K	73138	89P
A5R48	25-20-28R7K	Res, 28.7K, 1%, 1/8W		RN60C2872F
A5R49	25-25-4700	Res, 4.7K, 5%, ¼W		RC07GF472J
A5R50	26-95-10K	Res, 10K, 0.05%, 0.3W	18612	Style V53-1
A5R51	26-95-20K	Res, 20K, 0.05%, 0.3W	18612	Style V53-1
A5R52	25-25-4700	Res, 4.7K, 5%, ¼W		RC07GF472J
A5R53	26-95-10K	Res, 10K, 0.05%, 0.3W	18612	Style V53-1
A5R54	26-95-10K	Res, 10K, 0.05%, 0.3W	18612	Style V53-1
A5R55	25-25-3300	Res, 3.3K, 5%, ¼W		RC07GF332J
A5R56	25-20-10K	Res, 10K, 1%, 1/8W		RN60C1002F

TABLE 6-19. ASSEMBLY A5-438A-1 (W.E.) CONTROL LOGIC
PARTS LIST (cont)

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A5R57	25-20-15K	Res, 15K, 1%, 1/8W		RN601502F
A5R58	20-194-500	Res, Variable, 500 ohm	73138	89P
A5R59	25-25-2200	Res, 2.2K, 5%, ¼W		RC07GF222J
A5R60	25-25-1000	Res, 1K, 5%, ¼W		RC07GF102J
A5R61	25-8-100	Res, 100 ohm, 5%, ½W		RC20GF101J
A5R62	25-25-1000	Res, 1K, 5%, ¼W		RC07GF102J
A5R63	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R64	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R65	25-25-470	Res, 470 ohm, 5%, ¼W		RC07GF471J
A5R66	25-25-4700	Res, 4.7K, 5%, ¼W		RC07GF472J
A5R67	25-9-680	Res, 680 ohm, 5%, 1W		RC32GF681J
A5R68	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R69	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R70	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R71	25-25-470	Res, 470 ohm, 5%, ¼W		RC07GF471J
A5R72	25-25-4700	Res, 4.7K, 5%, ¼W		RC07GF472J
A5R73	25-9-680	Res, 680 ohm, 5%, 1W		RC32GF681J
A5R74	25-25-330K	Res, 330K, 5%, ¼W		RC07GF334J
A5R75	25-25-3300	Res, 3.3K, 5%, ¼W		RC07GF332J
A5R76	25-25-6800	Res, 6.8K, 5%, ¼W		RC07GF682J
A5R77	25-25-22K	Res, 22K, 5%, ¼W		RC07GF223J
A5R78	25-25-6800	Res, 6.8K, 5%, ¼W		RC07GF682J
A5R79	25-25-47K	Res, 47K, 5%, ¼W		RC07GF473J
A5R80	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R81	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R82	25-25-220	Res, 2.2K, 5%, ¼W		RC07GF222J
A5R83	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R84	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R85	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R86	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R87	25-9-680	Res, 680 ohm, 5%, 1W		RC32GF681J
A5R88	25-25-560	Res, 560 ohm, 5%, ¼W		RC07GF561J
A5R89	25-25-220K	Res, 220K, 5%, ¼W		RC07GF224J
A5R90	25-25-1000	Res, 1K, 5%, ¼W		RC07GF102J
A5R91	25-25-1500	Res, 1.5K, 5%, ¼W		RC07GF152J
A5R92	25-25-3300	Res, 3.3K, 5%, ¼W		RC07GF332J
A5R93	25-25-15K	Res, 15K, 5%, ¼W		RC07GF153J
A5R94	25-20-845	Res, 845 ohm, 1%, 1/8W		RN60C8450F
A5R95	25-25-820	Res, 820 ohm, 5%, ¼W		RC07GF821J
A5R96	25-20-2R6K	Res, 2.6K, 1%, 1/8W		RN60C2602F
A5R97	25-20-8R25K	Res, 8.25K, 1%, 1/8W		RN60C8251F
A5R98	25-25-6800	Res, 6.8K, 5%, ¼W		RC07GF682J
A5R99	25-9-680	Res, 680 ohm, 5%, 1W		RC32GF681J
A5R100	25-25-150	Res, 150 ohm, 5%, ¼W		RC07GF151J
A5R101	25-25-4700	Res, 4.7K, 5%, ¼W		RC07GF472J
A5R102	25-25-12K	Res, 12K, 5%, ¼W		RC07GF123J
A5R103	25-25-470	Res, 470 ohm, 5%, ¼W		RC07GF471J

TABLE 6-19. ASSEMBLY A5-438A-1 (W.E.) CONTROL LOGIC
PARTS LIST (cont)

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A5R104	25-20-1R47K	Res, 1.47K, 1%, 1/8W		RN60C1471F
A5R105	25-25-560	Res, 560 ohm, 5%, ¼W		RC07GF561J
A5R106	25-25-1000	Res, 1K, 5%, ¼W		RC08GF102J
A5R107	25-25-4700	Res, 4.7K, 5%, ¼W		RC07GF472J
A5R108	25-25-100	Res, 100 ohm, 5%, ¼W		RC07GF101J
A5R109	25-25-220	Res, 220 ohm, 5%, ¼W		RC07GF221J
A5R110	25-8-200	Res, 200 ohm, 5%, ½W		RC20GF201J
A5R111	25-25-100	Res, 100 ohm, 5%, ¼W		RC07GF101J
A5R112	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R113	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5$114	25-25-470	Res, 470 ohm, 5%, ¼W		RC07GF471J
A5R115	25-25-4700	Res, 4.7K, 5%, ¼W		RC07GF472J
A5TP1	62-153	Pin, Receptacle	71279	460-2970-02-03-00
A5TP2	62-153	Pin, Receptacle	71279	460-2970-02-03-00
A5TP3	62-153	Pin, Receptacle	71279	460-2970-02-03-00
A5TP4	62-153	Pin, Receptacle	71279	460-2970-02-03-00
A5TP5	62-153	Pin, Receptacle	71279	460-2970-02-03-00
A5TP6	62-153	Pin, Receptacle	71279	460-2970-02-03-00

TABLE 6-20. ASSEMBLY A5-438A-1 (OM) CONTROL LOGIC PARTS LIST

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A5	C139-459	Circuit Board Assembly Control Logic	93459	
A5C1		Cap, TBD		
A5C2	34-22-R1	Cap, 0.1 µf, 10%, 50V		CK06BX104K
A5C3	34-21-22	Cap, 22 pf, 10%, 200V		CK05BX220K
A5C4	34-21-150	Cap, 150 pf, 10%, 200V		CK05BX151K
A5C5	34-22-R1	Cap, 0.1 µf, 10%, 50V		CK06BX104K
A5C6	34-21-R001	Cap, 0.001 µf, 10%, 200V		CK05BX102K
A5C7	34-21-R001	Cap, 0.001 µf, 10%, 200V		CK05BX102K
A5C8	34-22-R01	Cap, 0.01 µf, 10%, 100V		CK06BX103K
A5C9	34-21-470	Cap, 470 pf, 10%, 100V		CK05BX471K
A5C10	34-21-470	Cap, 470 pf, 10%, 100V		CK05BX471K
A5C11	34-21-470	Cap, 470 pf, 10%, 100V		CK05BX471K
A5C12	34-21-470	Cap, 470 pf, 10%, 100V		CK05BX471K
A5C13	34-21-R0022	Cap, 0.0022 µf, 10%, 100V		CK06BX222K
A5C14	34-22-R1	Cap, 0.1 µf, 10%, 50V		CK06BX104K
A5C15	34-22-R1	Cap, 0.1 µf, 10%, 50V		CK06BX104K
A5C16	34-21-100	Cap, 100 pf, 10%, 200V		CK05BX101K
A5C17		Cap, TBD		
A5C18	34-21-R0022	Cap, 0.0022 µf, 10%, 100V		CK06BX222K
A5C19	34-21-56	Cap, 56 pf, 10%, 100V		CK05BX560K
A5C20	34-22-R1	Cap, 0.1 µf, 10%, 50V		CK06BX104K
A5C21	34-21-100	Cap, 100 pf, 10%, 200V		CK05BX101K
A5C22	34-22-R1	Cap, 0.1 µf, 10%, 50V		CK06BX104K
A5C23	34-21-10	Cap, 10 pf, 10%, 200V		CK06BX100K
A5C24	34-22-R01	Cap, 0.01 µf, 10%, 100V		CK06BX103K
A5C25	34-21-100	Cap, 100 pf, 10%, 200V		CK05BX101K
A5CR1	12-51	Diode		1N914B
A5CR2	12-51	Diode		1N914B
A5CR3	12-51	Diode		1N914B
A5CR4	12-51	Diode		1N914B
A5CR5	12-51	Diode		1N914B
A5CR6	12-51	Diode		1N914B
A5CR7	12-51	Diode		1N914B
A5CR8	12-51	Diode		1N914B
A5CR9	12-51	Diode		1N914B
A5CR10	12-51	Diode		1N914B
A5CR11	12-51	Diode		1N914B
A5CR12	12-51	Diode		1N914B
A5CR13	12-51	Diode		1N914B
A5CR14	12-51	Diode		1N914B
A5CR15	12-51	Diode		1N914B
A5CR16	12-51	Diode		1N914B
A5CR17	12-51	Diode		1N914B
A5CR18	12-51	Diode		1N914B
A5CR19	12-51	Diode		1N914B
A5CR20	12-51	Diode		1N914B
A5IC1	12-170	Circuit, Integrated	04713	MC830P

TABLE 6-20. ASSEMBLY A5-438A-1 (OM) CONTROL LOGIC
PARTS LIST (cont)

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A5IC2	12-172	Transistor Array	02735	CA3046
A5IC3	12-250	Circuit, Integrated	02735	CD4016AE
A5IC4	12-250	Circuit, Integrated	02735	CD4016AE
A5IC5	12-165	Amplifier Operational	27014	LM301AH
A5IC6	12-192	Circuit, Integrated	04713	MC1458P
A5IC7	12-165	Amplifier Operational	27014	LM301AH
A5IC8	12-192	Circuit, Integrated	04713	MC1458P
A5K1	47-29	Relay, Reed	12300	JRM1049
A5Q1	12-140	Transistor		2N4403
A5Q2	12-140	Transistor		2N4403
A5Q3	12-140	Transistor		2N4403
A5Q4	12-139	Transistor		2N4401
A5Q5	12-139	Transistor		2N4401
A5Q6	12-140	Transistor		2N4403
A5Q7	12-140	Transistor		2N4403
A5Q8	12-139	Transistor		2N4401
A5Q9	12-139	Transistor		2N4401
A5Q10	12-139	Transistor		2N4401
A5Q11	12-139	Transistor		2N4401
A5Q12	12-139	Transistor		2N4401
A5Q13	12-140	Transistor		2N4403
A5Q14	12-140	Transistor		2N4403
A5Q15	12-140	Transistor		2N4403
A5Q16	12-139	Transistor		2N4401
A5Q17	12-139	Transistor		2N4401
A5Q18	12-139	Transistor		2N4401
A5Q19	12-139	Transistor		2N4401
A5Q20	12-140	Transistor		2N4403
A5Q21	12-140	Transistor		2N4403
A5Q22	12-140	Transistor		2N4403
A5Q23	12-140	Transistor		2N4403
A5Q24	12-139	Transistor		2N4401
A5Q25	12-140	Transistor		2N4403
A5Q26	12-140	Transistor		2N4403
A5Q27	12-139	Transistor		2N4401
A5Q28	12-139	Transistor		2N4401
A5Q29	12-139	Transistor		2N4401
A5Q30	12-140	Transistor		2N4403
A5Q31	12-139	Transistor		2N4401
A5Q32	12-140	Transistor		2N4403
A5Q33	12-139	Transistor		2N4401
A5Q34	12-140	Transistor		2N4403
A5Q35	12-139	Transistor		2N4401
A5Q36	12-139	Transistor		2N4401
A5Q37	12-139	Transistor		2N4401
A5Q38	12-140	Transistor		2N4403
A5Q39	12-140	Transistor		2N4403

TABLE 6-20. ASSEMBLY A5-438A-1 (OM) CONTROL LOGIC PARTS LIST (cont)

REFERENCE DESIGNATION	# PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A5Q40	12-139	Transistor		2N4401
A5Q41	12-139	Transistor		2N4401
A5Q42	12-140	Transistor		2N4403
A5Q43	12-139	Transistor		2N4401
A5Q44	12-140	Transistor		2N4403
A5R1	25-25-6800	Res, 6800 ohm, 5%, ¼W		RC07GF682J
A5R2	25-25-6800	Res, 6800 ohm, 5%, ¼W		RC07GF682J
A5R3	25-25-1500	Res, 1500 ohm, 5%, ¼W		RC07GF152J
A5R4	25-25-470	Res, 470 ohm, 5%, ¼W		RC07GF471J
A5R5	25-25-4700	Res, 4700 ohm, 5%, ¼W		RC07GF472J
A5R6	25-25-4700	Res, 4700 ohm, 5%, ¼W		RC07GF472J
A5R7	25-25-4700	Res, 4700 ohm, 5%, ¼W		RC07GF472J
A5R8	25-25-15K	Res, 15K, 5%, ¼W		RC07GF153J
A5R9	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R10	25-25-150	Res, 150 ohm, 5%, ¼W		RC07GF151J
A5R11	25-25-4700	Res, 4700 ohm, 5%, ¼W		RC07GF472J
A5R12	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R13	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R14	25-25-150	Res, 150 ohm, 5%, ¼W		RC07GF151J
A5R15	25-25-4700	Res, 4700 ohm, 5%, ¼W		RC07GF472J
A5R16	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R17	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R18	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R19	25-20-	Res, TBD, 1%, 1/8W		RN60C
A5R20	25-20-	Res, TBD, 1%, 1/8W		RN60C
A5R21	25-20-	Res, TBD, 1%, 1/8W		RN60C
A5R22	25-20-	Res, TBD, 1%, 1/8W		RN60C
A5R23	25-25-100K	Res, 100K, 5%, ¼w		RC07GF104J
A5R24	25-25-10	Res, 10K, 5%, ¼W		RC07GF103J
A5R25	25-8-680	Res, 680 ohm, 5%, ½W		RC20GF681J
A5R26	25-8-680	Res, 680 ohm, 5%, ½W		RC20GF681J
A5R27	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R28	25-25-470	Res, 470 ohm, 5%, ¼W		RC07GF471J
A5R29	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R30	25-25-4700	Res, 4700 ohm, 5%, ¼W		RC07GF472J
A5R31	25-8-680	Res, 680 ohm, 5%, ½W		RC20GF681J
A5R32	25-8-680	Res, 680 ohm, 5%, ½W		RC20GF681J
A5R33	25-20-8R25K	Res, 8.25K, 1%, 1/8W		RN60C8251F
A5R34	25-25-1000	Res, 1000 ohm, 5%, ¼W		RC07GF102J
A5R35	25-25-68K	Res, 68K, 5%, ¼W		RC07GF683J
A5R36	25-25-1500	Res, 1500 ohm, 5%, ¼W		RC07GF152J
A5R37	25-25-470	Res, 470 ohm, 5%, ¼W		RC07GF471J
A5R38	25-25-	Res, TBD, 5%, ¼W		RC07GF
A5R39	25-25-12K	Res, 12K, 5%, ¼W		RC07GF123J
A5R40	25-25-4700	Res, 4700 ohm, 5%, ¼W		RC07GF472J
A5R41	25-20-1R47K	Res, 1.47K, 1%, 1/8W		RN60C1471F
A5R42	25-25-1000	Res, 1000 ohm, 5%, ¼W		RC07GF102J
A5R43	25-25-560	Res, 560 ohm, 5%, ¼W		RC07GF561J

TABLE 6-20. ASSEMBLY A5-438A-1 (OM) CONTROL LOGIC
PARTS LIST (cont)

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A5R44	25-25-100	Res, 100 ohm, 5%, ¼W		RC07GF101J
A5R45	25-8-220	Res, 220 ohm, 5%, ½W		RC20GF221J
A5R46	25-20-10K	Res, 10K, 1%, 1/8W		RN60C1002F
A5R47	20-195-1000	Res, Variable, 1000 ohm	73138	89P
A5R48	25-20-10K	Res, 10K, 1%, 1/8W		RN60C1002F
A5R49	25-20-10K	Res, 10K, 1%, 1/8W		RN60C1002F
A5R50	25-25-6800	Res, 6800 ohm, 5%, ¼W		RC07GF682J
A5R51	25-20-10K	Res, 10K, 1%, 1/8W		RN60C1002F
A5R52	25-25-33K	Res, 33K, 5%, ¼W		RC07GF333J
A2R53	25-25-68	Res, 68 ohm, 5%, ¼W		RC07GF680J
A5R54	25-25-4700	Res, 4700 ohm, 5%, ¼W		RC07GF472J
A5R55	25-25-1000	Res, 1000 ohm, 5%, ¼W		RC07GF102J
A5R56	25-95-10K	Res, 10K, 5%, 3W		RW79U1002J
A5R57	25-25-1000	Res, 1000 ohm, 5%, ¼W		RC07GF102J
A5R58	26-95-10K	Res, 10K, 5%, 3W		RW79U1002J
A5R59	25-25-4700	Res, 4700 ohm, 5%, ¼W		RC07GF472J
A5R60	25-25-4700	Res, 4700 ohm, 5%, ¼W		RC07GF472J
A5R61	25-20-10K	Res, 10K, 1%, 1/8W		RN60C1002F
A5R62	20-195-500	Res, Variable, 500 ohm	73138	89P
A5R63	25-20-15K	Res, 15K, 1%, 1/8W		RN60C1502F
A5R64	26-95-20K	Res, 20K, 5%, 3W		RW79U2002J
A5R65	25-25-4700	Res, 4700 ohm, 5%, ¼W		RC07GF472J
A5R66	25-20-28R7K	Res, 28.7K, 1%, 1/8W		RN60C2872F
A5R67	20-195-2000	Res, Variable, 2K	73138	89P
A5R68	26-95-20K	Res, 20K, 5%, 3W		RW79U2002J
A5R69	26-95-10K	Res, 10K, 5%, 3W		RW79U1002J
A5R70	25-25-3300	Res, 3300 ohm, 5%, ¼W		RC07GF332J
A5R71	25-25-4700	Res, 4700 ohm, 5%, ¼W		RC07GF472J
A5R72	25-20-287	Res, 287 ohm, 1%, 1/8W		RN60C2870F
A5R73	25-20-10K	Res, 10K, 1%, 1/8W		RN60C1002F
A5R74	25-20-15K	Res, 15K, 1%, 1/8W		RN60C1502F
A5R75	26-95-10K	Res, 10K, 5%, 3W		RW79U1002J
A5R76	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R77	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R78	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R79	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R80	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R81	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R82	25-25-4700	Res, 4700 ohm, 5%, ¼W		RC07GF472J
A5R83	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R84	25-25-470	Res, 470 ohm, 5%, ¼W		RC07GF471J
A5R85	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R86	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R87	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R88	25-8-220	Res, 220 ohm, 5%, ½W		RC07GF221J

TABLE 6-20. ASSEMBLY A5-438A-1 (OM) CONTROL LOGIC
PARTS LIST (cont)

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A5R89		Not Used		
A5R90	25-25-1000	Res, 1000 ohm, 5%, ¼W		RC07GF102J
A5R91	25-25-1000	Res, 1000 ohm, 5%, ¼W		RC07GF102J
A5R92	25-25-1000	Res, 1000 ohm, 5%, ¼W		RC07GF102J
A5R93	25-25-1000	Res, 1000 ohm, 5%, ¼W		RC07GF102J
A5R94	25-25-15K	Res, 15K, 5%, ¼W		RC07GF153J
A5R95	25-20-20K	Res, 20K, 1%, 1/8W		RN60C2002F
A5R96	25-20-20K	Res, 20K, 1%, 1/8W		RN60C2002F
A5R97	25-20-15K	Res, 15K, 1%, 1/8W		RN60C1502F
A5R98	25-25-330K	Res, 330K, 5%, ¼W		RC07GF334J
A5R99	25-20-22R1K	Res, 22.1K, 1%, 1/8W		RN60C2212F
A5R100	25-20-221K	Res, 221K, 1%, 1/8W		RN60C2213F
A5R101	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R102	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R103	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R104	25-25-2200	Res, 2200 ohm, 5%, ¼W		RC07GF222J
A5R105	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R106	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R107	25-25-560	Res, 560 ohm, 5%, ¼W		RC07GF561J
A5R108	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R109	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R110	25-25-15K	Res, 15K, 5%, ¼W		RC07GF153J
A5R111	25-25-4700	Res, 4700 ohm, 5%, ¼W		RC07GF472J
A5R112	25-25-3300	Res, 3300 ohm, 5%, ¼W		RC07GF332J
A5R113	25-25-1000	Res, 1000 ohm, 5%, ¼W		RC07GF102J
A5R114	25-25-4700	Res, 4700 ohm, 5%, ¼W		RC07GF472J
A5R115	25-25-4700	Res, 4700 ohm, 5%, ¼W		RC07GF472J
A5R116	25-25-220	Res, 220 ohm, 5%, ¼W		RC07GF221J
A5R117	25-25-100	Res, 100 ohm, 5%, ¼W		RC07GF101J
A5R118	25-25-6800	Res, 6800 ohm, 5%, ¼W		RC07GF682J
A5R119	25-25-150	Res, 150 ohm, 5%, ¼W		RC07GF151J
A5R120	25-25-3300	Res, 3300 ohm, 5%, ¼W		RC07GF332J
A5R121	25-25-15K	Res, 15K, 5%, ¼W		RC07GF153J
A5R122	25-20-2R61K	Res, 2.61K, 1%, 1/8W		RN60C2611F
A5R123	25-20-845	Res, 845 ohm, 1%, 1/8W		RN60C8450F
A5R124	25-25-820	Res, 820 ohm, 5%, ¼W		RC07GF821J
A5R125	25-25-820	Res, 820 ohm, 5%, ¼W		RC07GF821J
A5R126	25-25-1000	Res, 1000 ohm, 5%, ¼W		RC07GF102J
A5R127	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R128	25-25-10K	Res, 10K, 5%, ¼W		RC07GF103J
A5R129		Not Used		
A5R130	25-25-5100	Res, 5100 ohm, 5%, ¼W		RC07GF512J
A5R131	25-25-3600	Res, 3600 ohm, 5%, ¼W		RC07GF362J
A5R132	25-25-12K	Res, 12K, 5%, ¼W		RC07GF123J
A5R133	25-25-390	Res, 390 ohm, 5%, ¼W		RC07GF391J
A5R134	25-25-2700	Res, 2700 ohm, 5%, ¼W		RC07GF272J
A5R135	25-25-1000	Res, 1000 ohm, 5%, ¼W		RC07GF102J

TABLE 6-20. ASSEMBLY A5-438A-1 (OM) CONTROL LOGIC
PARTS LIST (cont)

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A5R136	25-25-1000	Res, 1000 ohm, 5%, ¼W		RC07GF102J
A5R137	25-25-560	Res, 560 ohm, 5%, ¼W		RC07GF561J
A5TP1	62-153	Pin, Receptacle	71279	460-2970-02-03-00
A5TP2	62-153	Pin, Receptacle	71279	460-2970-02-03-00
A5TP3	62-153	Pin, Receptacle	71279	460-2970-02-03-00

TABLE 6-21. ASSEMBLY A3-438A (OM) HEATER
PARTS LIST

REFERENCE DESIGNATION	* PART NUMBER	DESCRIPTION	MFR CODE	MFR PART NUMBER
A3	A139-476	Circuit Board Assembly, Auxiliary Reference Supply	93459	
A3C1	31-80	Cap, 10 μf, 20%, 35V	31433	T362C106M035
A3CR1	12-266	Diode, Zener, 30V		1N5256
A3Q1	12-208	Transistor, PNP	04713	MJE105
A3R1	25-25-1000	Res, 1000 ohm, 5%, ¼W		RC07GF102J
A3R2	25-9-47	Res, 47 ohm, 5%, 1W		RC32GF470J

SECTION 7
ASSEMBLY DRAWINGS AND SCHEMATICS

7.1 INTRODUCTION

This section contains assembly drawings, schematic diagrams and component location drawings for the RF Unit Assembly and subassemblies. Table 7-1, on the following page, provides schematic notes which are unique to the diagrams and drawings of this section.

7.2 LIST OF FIGURES

The following is a list of figures included in this section.

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Table 7-1. Schematic Notes

1. Resistance in ohms, capacitance in microfarads unless otherwise indicated.

2. Screwdriver adjustment

Front panel control

3. Front panel designation

Rear panel designation

4. Printed circuit card border

 Main signal path

Semi-Rigid Coaxial

5. P/O = part of

6.

Wiper moves toward CW when control rotated clockwise

7. Test point.

8. Zener diode; SCR

9. Cons. Current Diode

10.

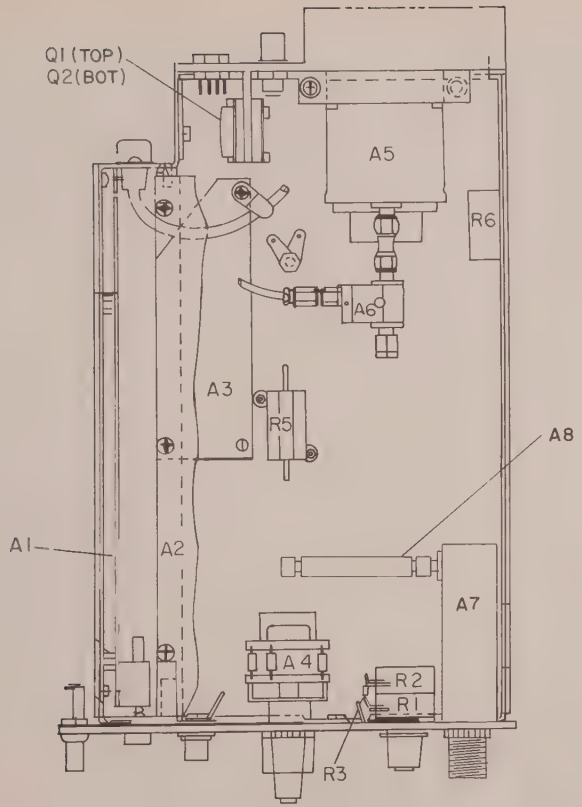
Indicates Socket connections and pin numbers.

11.

Indicates solder connection and pin numbers.

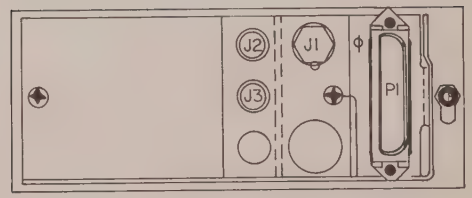
12. Denotes chassis ground

13. Denotes signal ground



TOP VIEW

REAR PANEL ASSY



FRONT PANEL ASSY

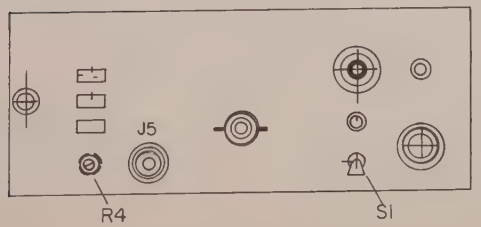


Figure 7-1. Typical YIG or Varactor Tuned RF Unit, Assembly and Component Identification

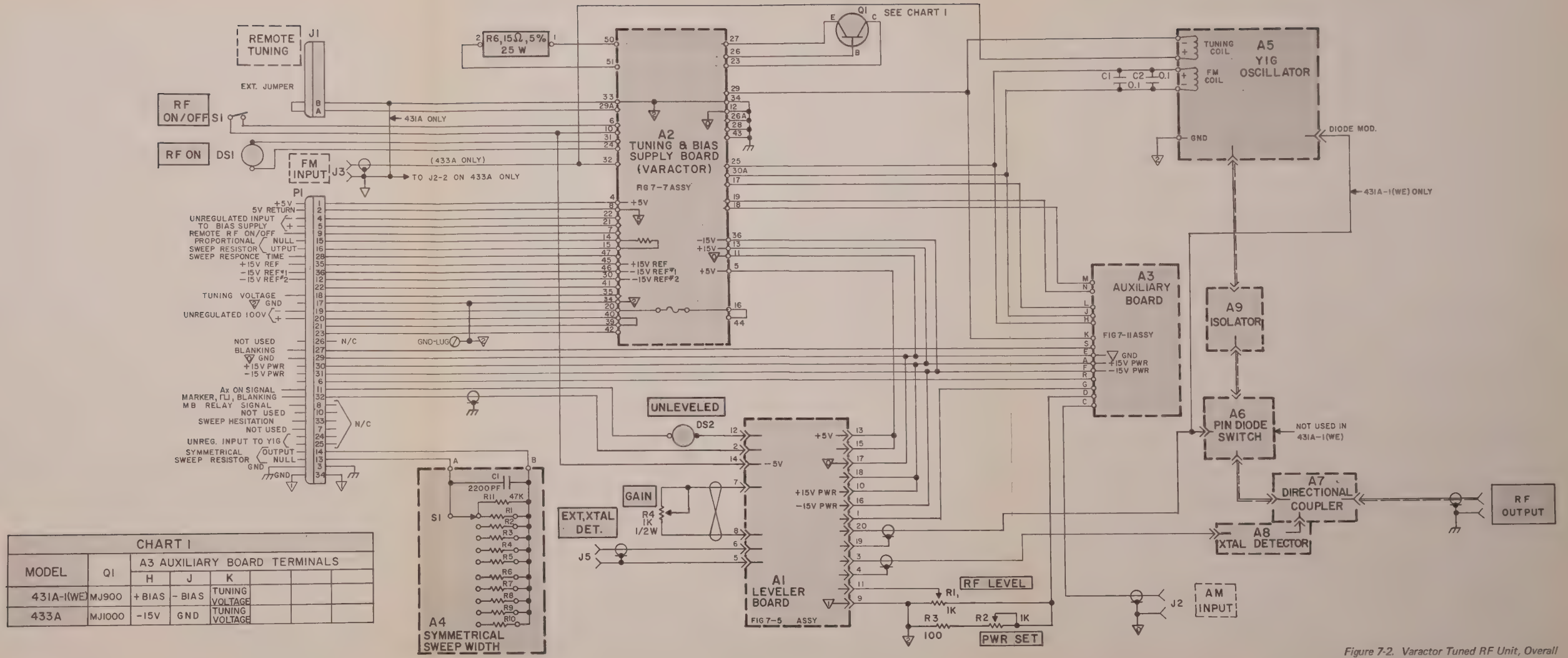


CHART I

MODEL	Q1	A3 AUXILIARY BOARD TERMINALS					
		H	J	K			
431A-1(WE)	MJ900	+BIAS	-BIAS	TUNING VOLTAGE			
433A	MJ1000	-15V	GND	TUNING VOLTAGE			

Figure 7-2. Varactor Tuned RF Unit, Overall Schematic Diagram

CHART 1

MODEL	Q1	Q2	R5		R7	CR1	CR2
432A AVANTEK	MJ900	MJ1000	34.8Ω 1% 10W		N/A	UNITRODE UZ5722	IN4733A
433A AVANTEK	MJ900	MJ1000	11.0 Ω 1% 25W		N/A	UNITRODE UZ 5717	IN4733A
434A VARIAN	MJ900	MJ1000	9.76Ω 1% 25W		8 Ω 5% 25W	NOTE 4	N/A
434A WJ	MJ1000	MJ1000	7.5 Ω 1% 50W		8 Ω 5% 25W	NOTE 4	N/A
435A VARIAN	MJ900	MJ1000	6.8 Ω 1% 50W		6 Ω 5% 25W	NOTE 4	N/A
435A WJ	MJ1000	MJ1000	5.6 Ω 1% 50W		6 Ω 5% 25W	NOTE 4	N/A
442A AVANTEK	MJ900	MJ1000	34.8Ω 1% 10W		N/A	UNITRODE UZ5722	IN4733A

CHART 2

MODEL	A3 AUXILIARY BOARD TERMINALS							RF SOURCE TERMINAL DESIGNATION
	H	J	K	L	M	N	P	
432A AVANTEK	+FM	−FM	TUNING	N/C	+20V	GND LUG	−5V	
433A AVANTEK	+FM	−FM	TUNING	TOP SIDE HEATER	+15V	GND LUG	−5V	
434A VARIAN	+FM	−FM	−SW	N/C	+VB	−VB	N/C	
434A WJ	(+FM) 8	7	2	N/C	6	3	N/C	
435A VARIAN	+FM	−FM	−SW	N/C	−VB	−VB	N/C	
435A WJ	(+FM) 8	7	2	N/C	6	3	N/C	
442A AVANTEK	+FM	−FM	TUNING	N/C	+20		−5V	

NOTE:

1. WHEN R7 IS NOT USED, WIRE DIRECTLY TO A3-K.
2. ALL GROUNDS TO BE TERMINATED AT GROUNDED LUGS.
3. USED ONLY ON MODELS 434A AND 435A.
4. VALUE SELECTED AT TEST.

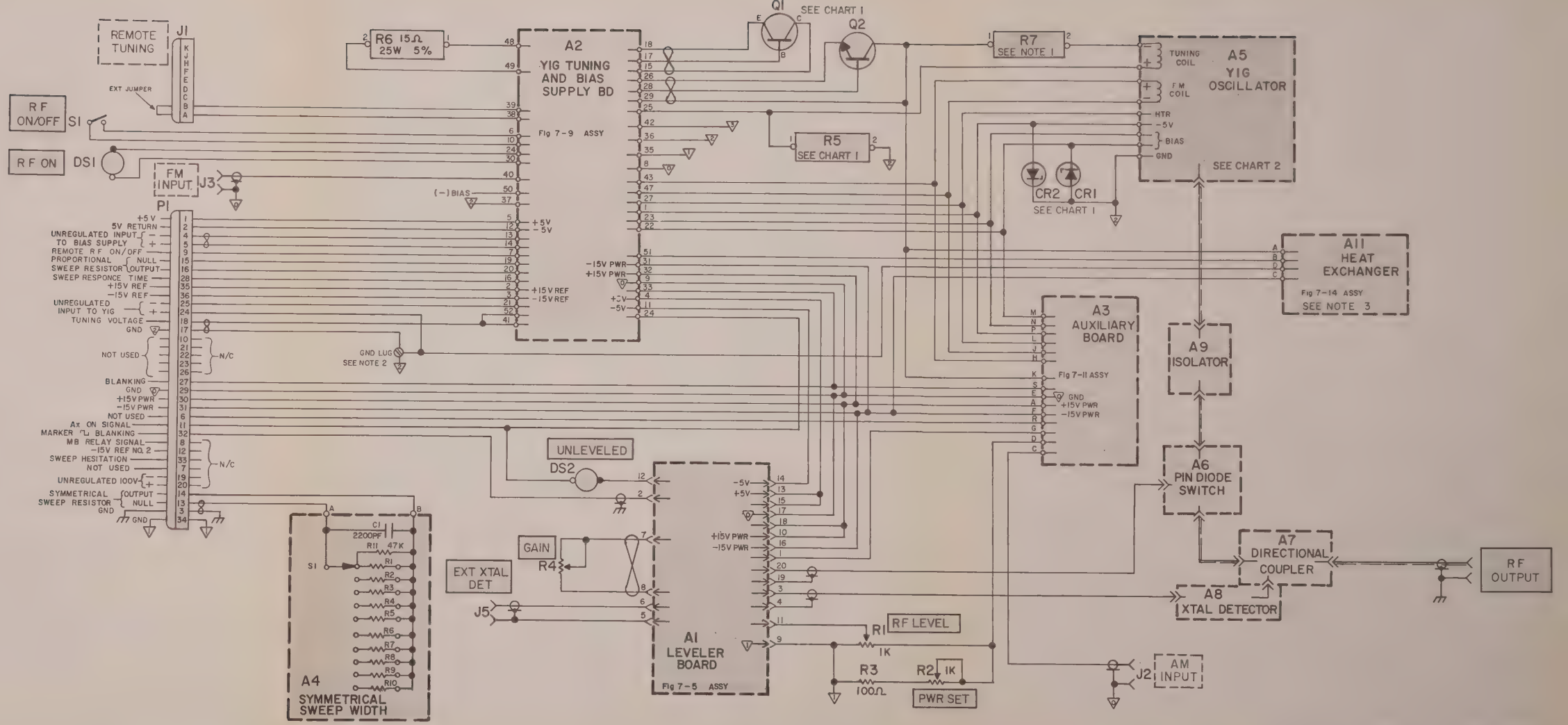
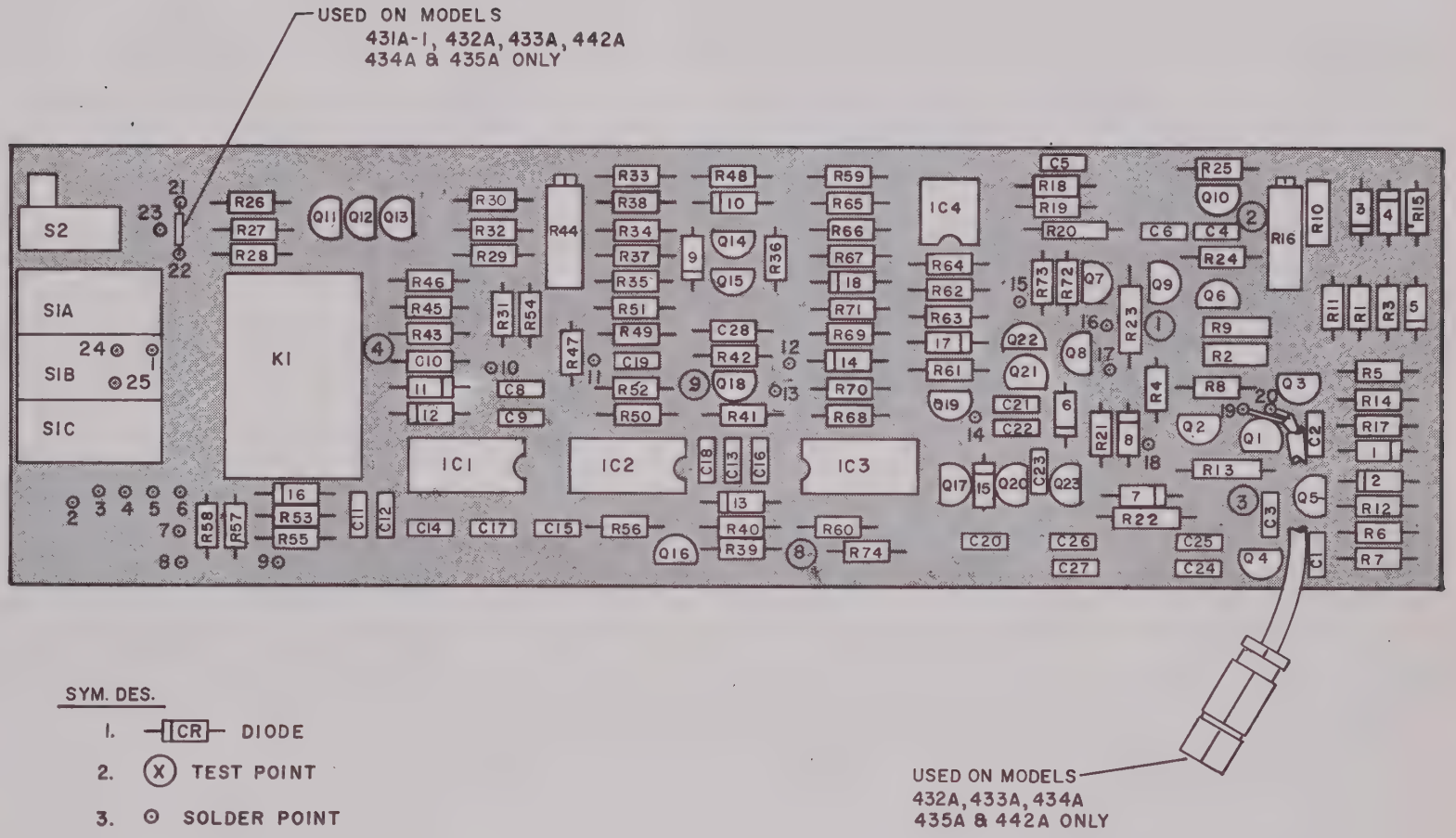
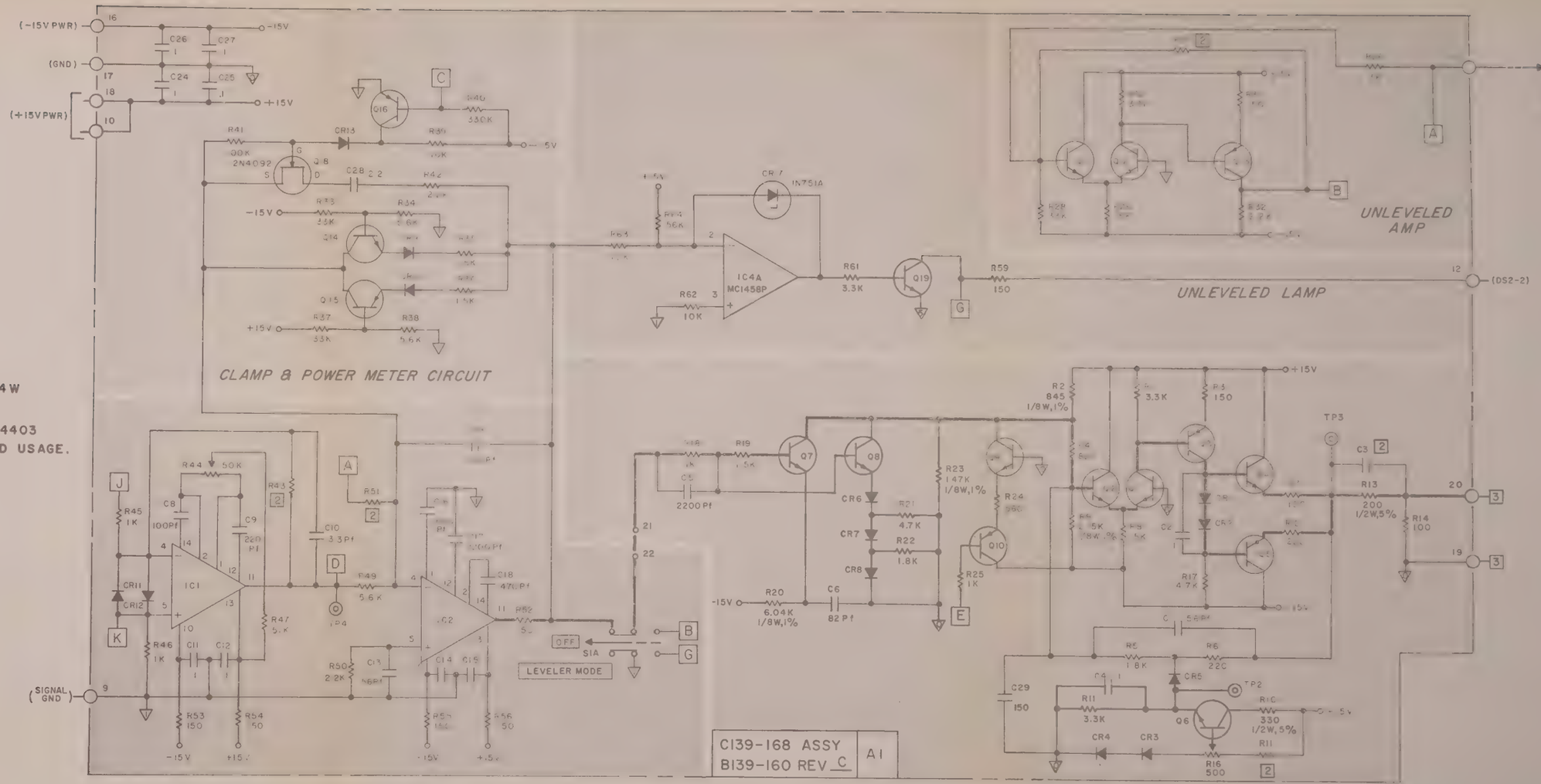


Figure 7-3. YIG Tuned RF Unit, Overall Schematic Diagram


USED ON MODELS
431A-1, 432A, 433A, 442A
434A & 435A ONLY
S2
SIA
SIB
SIC
K1
IC1
IC2
IC3
IC4
SYM. DES.
1. CR DIODE
2. X TEST POINT
3. SOLDER POINT
USED ON MODELS
432A, 433A, 434A
435A & 442A ONLY



NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL
   RESISTOR VALUES ARE IN OHMS, 5%, 1/4W
   CAPACITOR VALUES ARE IN μf
   DIODES ARE 1N914
   TRANSISTORS ARE NPN 2N4401, PNP 2N4403
2. SEE SPECIFIC PARTS LIST FOR VALUES AND USAGE.
3. SEE SPECIFIC OVERALL SCHEMATIC

(NOTES CONT. ON SHT 2 OF 2)

Figure 7-5. Leveler Assembly A1, Schematic Diagram (Sheet 1 of 2)

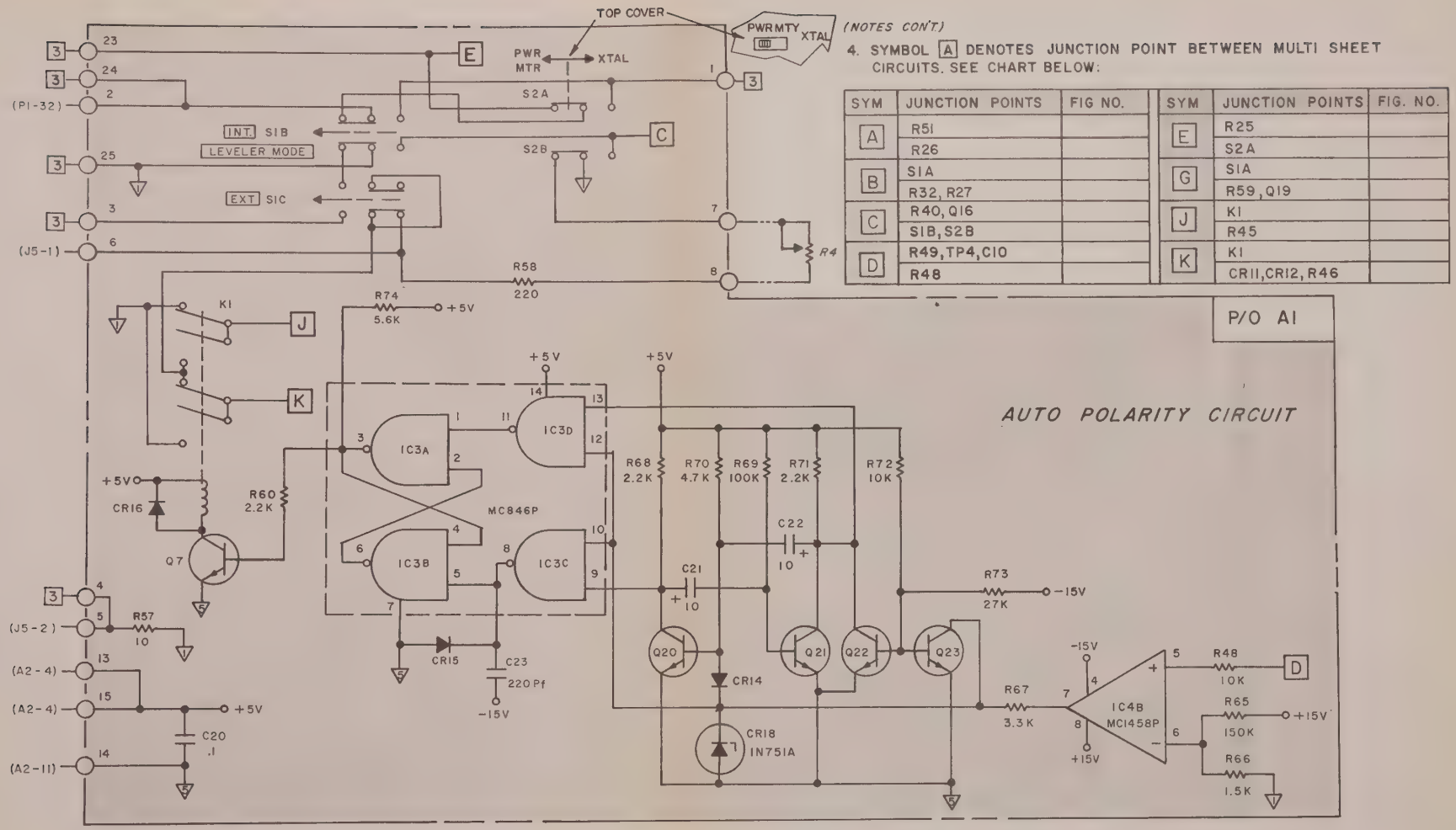


Figure 7-5. Leveler Assembly A1, Schematic Diagram (Sheet 2 of 2)

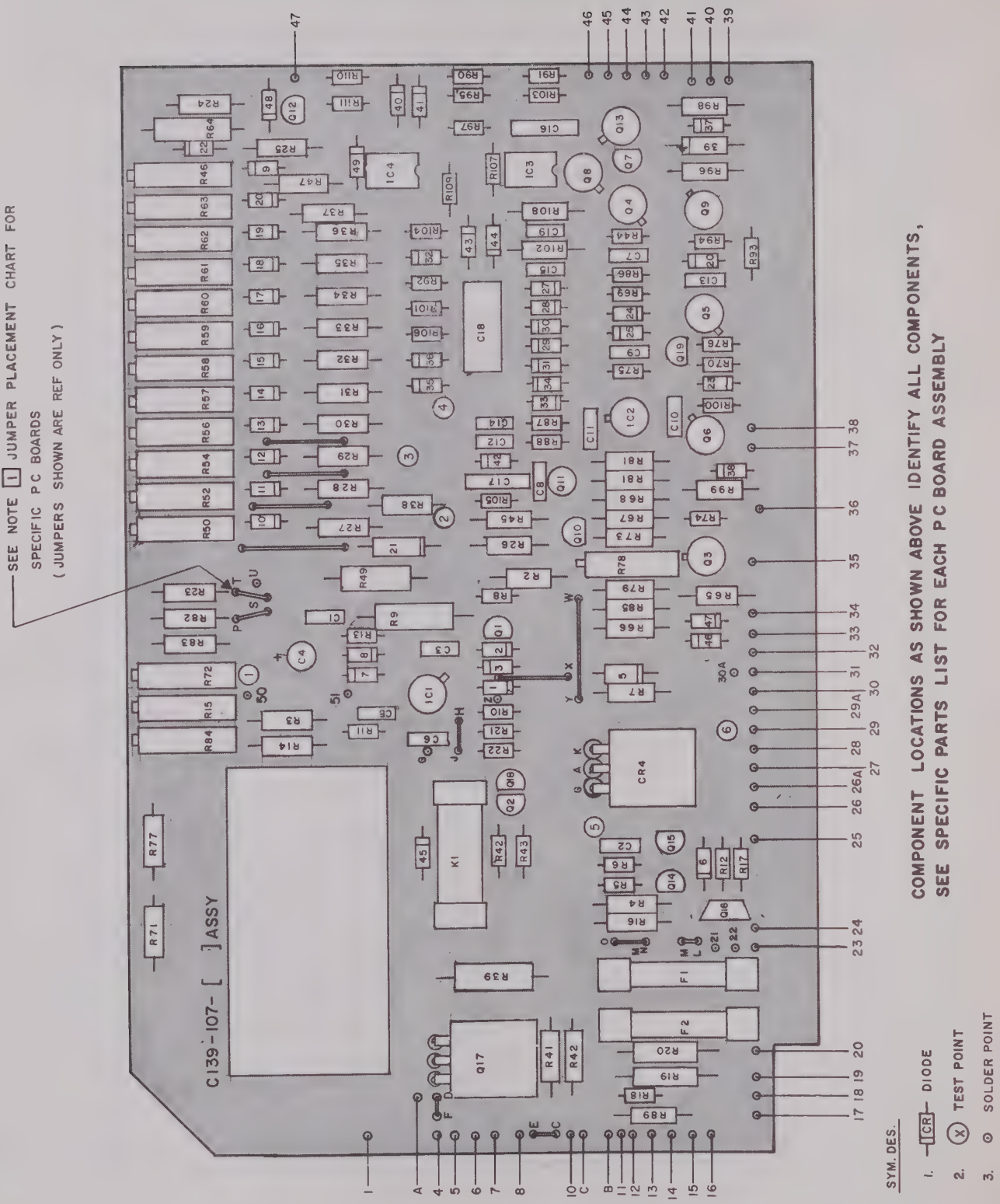

SEE NOTE 1 JUMPER PLACEMENT CHART FOR SPECIFIC PC BOARDS
(JUMPERS SHOWN ARE REF ONLY)
C139-107-[ ] ASSY
COMPONENT LOCATIONS AS SHOWN ABOVE IDENTIFY ALL COMPONENTS, SEE SPECIFIC PARTS LIST FOR EACH PC BOARD ASSEMBLY
SYM. DES.
1. CR DIODE
2. X TEST POINT
3. SOLDER POINT

Figure 7-6. Varactor Bias and Tuning Supply Assembly A2, Component Identification

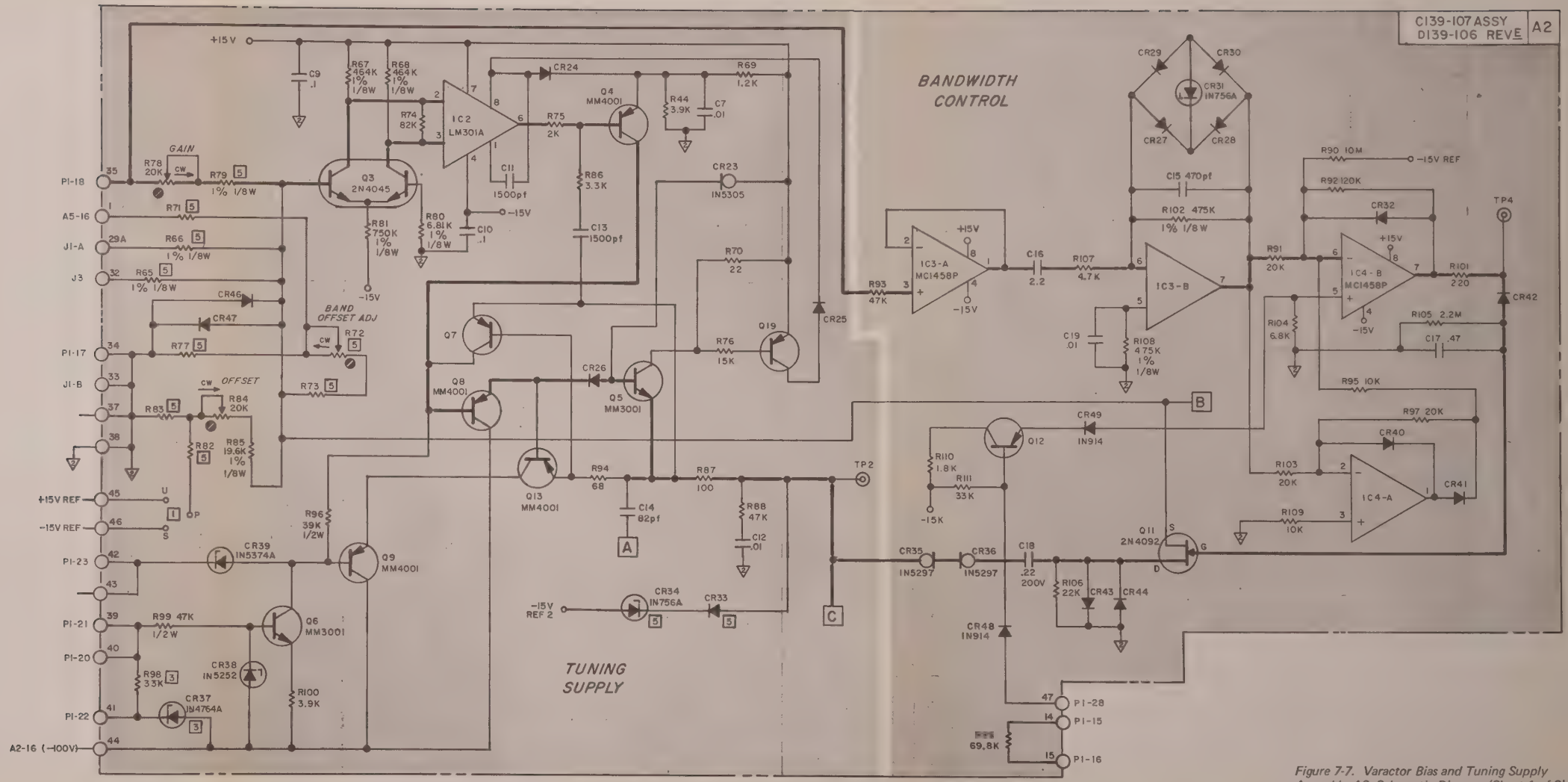


Figure 7-7. Varactor Bias and Tuning Supply Assembly A2, Schematic Diagram (Sheet 1 of 2)

NOTES:

[1]. JUMPER PLACEMENT CHART;

MODEL	431A-1(WE)		433A		438A-1(WE)	
	C139-107-1	C139-107-1MP	C139-107-2	C139-107-2MP	C139-107-3	C139-107-3MP
TYPE REGULATOR	POS	POS	NEG	NEG	POS	POS
TYPE TRANSISTOR Q1 / Q18	2N4403	2N4403	2N4401	2N4401	2N4403	2N4403
JUMPER PLACEMENT FROM	W TO Y P TO S X TO Z S TO T J TO H D TO F C TO E M TO L N TO O	W TO Y P TO S X TO Z S TO T J TO H A TO F B TO E M TO L N TO O	Y TO Z W TO X P TO U U TO T J TO G D TO F C TO E N TO L M TO O	Y TO Z W TO X P TO U U TO T J TO G A TO F B TO E N TO L M TO O	W TO Y P TO S X TO Z S TO T J TO H D TO F C TO E M TO L N TO O	W TO Y P TO S X TO Z S TO T J TO H A TO F B TO E M TO L N TO O

2. UNLESS OTHERWISE SPECIFIED ALL
RESISTORS VALUES ARE IN OHMS, 5%, 1/4 W
CAPACITORS VALUES ARE IN *uf* 10%, 200 V
DIODES ARE 1N483B
TRANSISTORS ARE NPN 2N4401, PNP 2N4403

[3]. USED ON MP MODIFICATION ONLY.

[4]. REVERSE POLARITY FOR NEGATIVE REGULATORS.

[5]. SEE SPECIFIC PART LIST FOR VALUES AND USAGE.

6. SYMBOL [A] DENOTES JUNCTION POINT BETWEEN MULTI SHEET CIRCUITS.
SEE CHART BELOW

SYM	JUNCTION POINTS	FIG NO.
[A]	C14	
	C8, R45	
[B]	Q11-S, R85, R73, Q3	
	Q10, C8, R45	
[C]	CR35, R87, R88, CR33	
	PIN 29, R38	

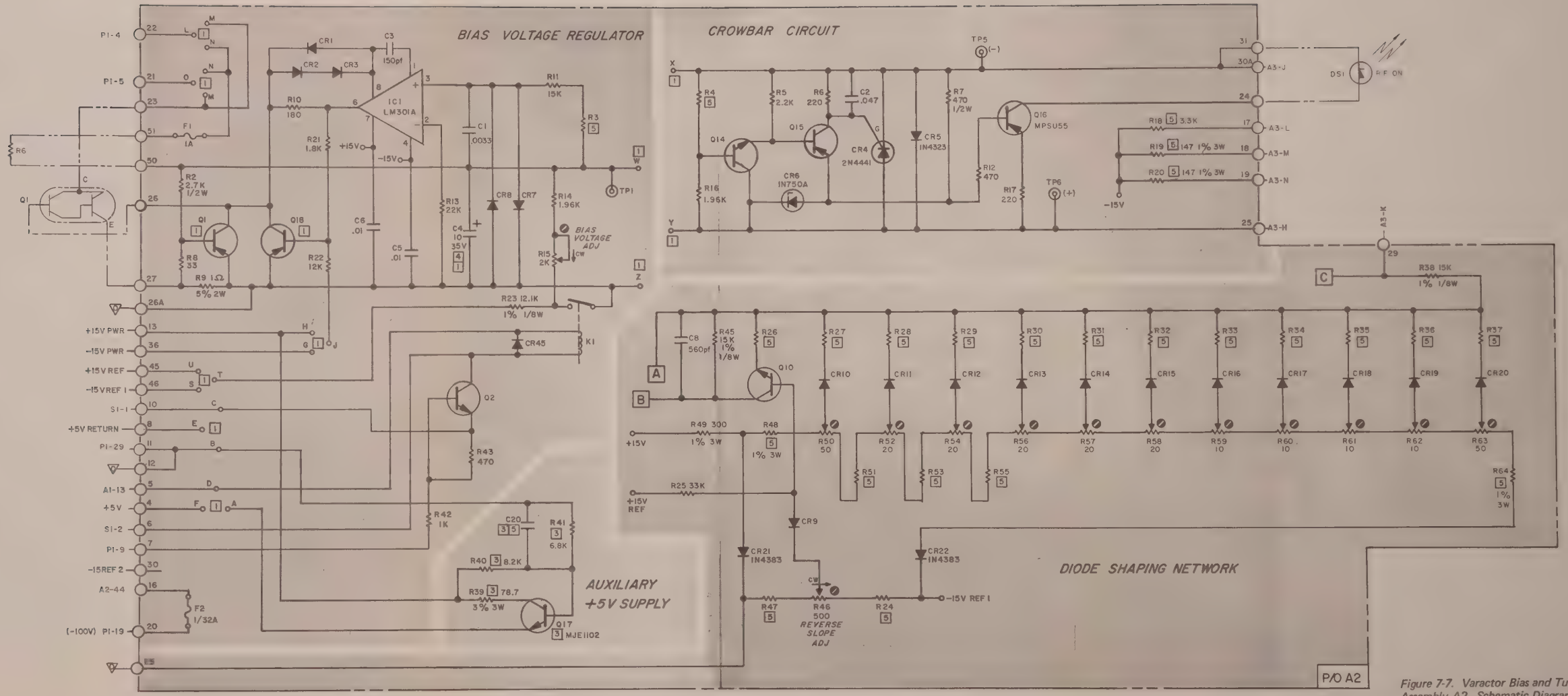


Figure 7-7. Varactor Bias and Tuning Supply Assembly A2, Schematic Diagram (Sheet 2 of 2)

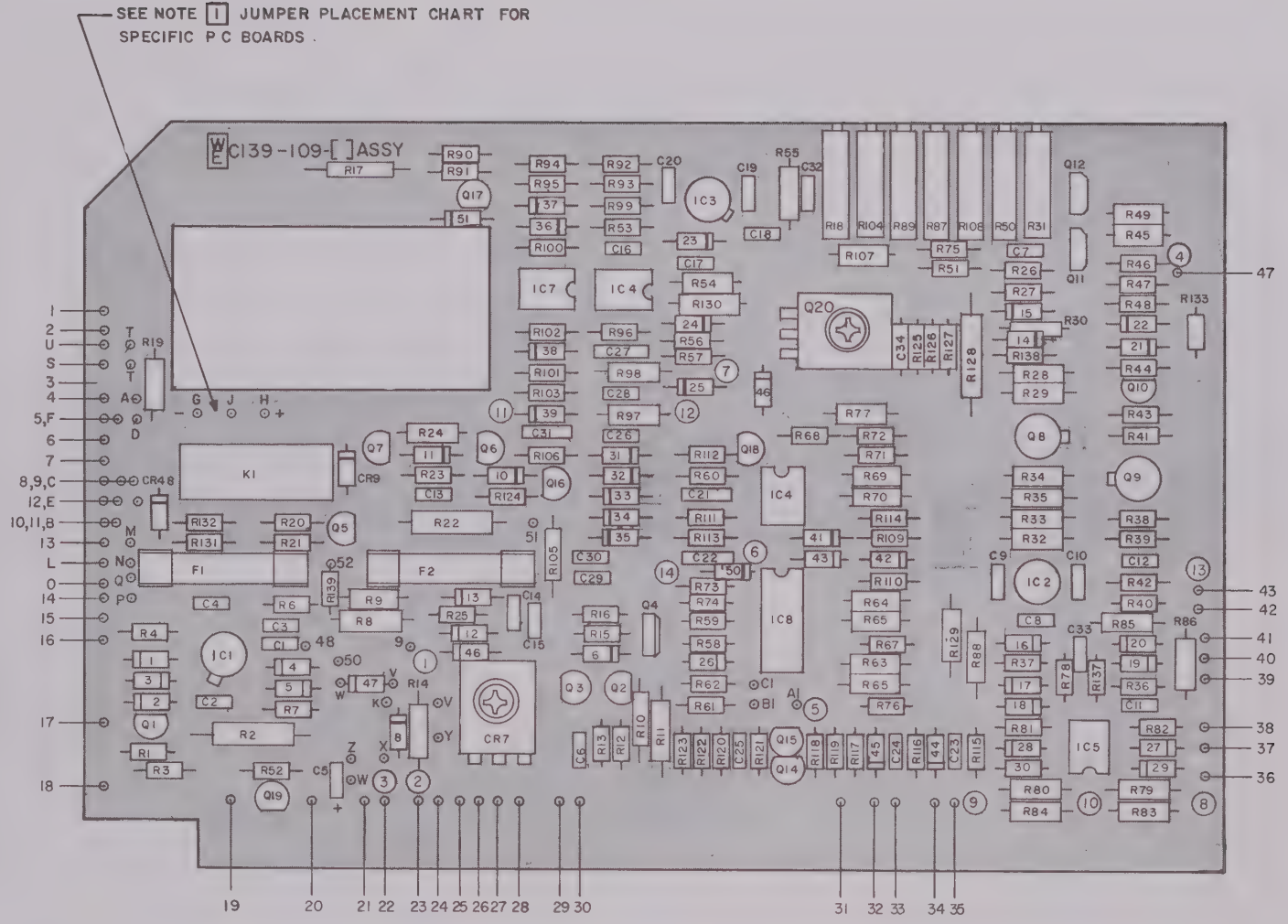

SEE NOTE [1] JUMPER PLACEMENT CHART FOR SPECIFIC P C BOARDS.
W/E C139-109-[ ]ASSY
SYM. DES.
1. DIODE
2. TEST POINT
3. SOLDER POINT
COMPONENT LOCATIONS AS SHOWN ABOVE, IDENTIFY ALL COMPONENTS
SEE SPECIFIC PARTS LIST FOR EACH PC BOARD

Figure 7-8. YIG Bias and Tuning Supply Assembly A2, Component Identification

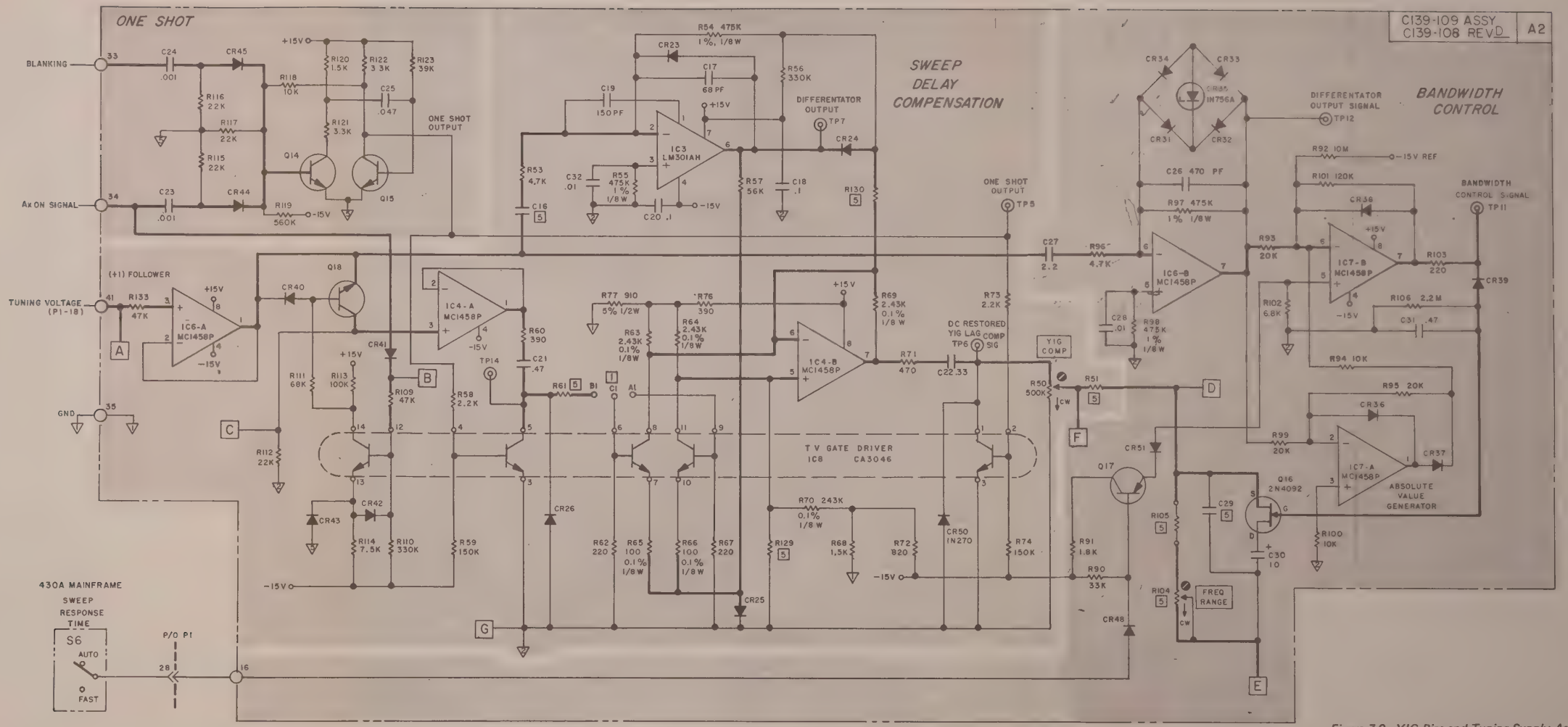


Figure 7-9. YIG Bias and Tuning Supply Assembly A2, Schematic Diagram (Sheet 1 of 3)

NOTES:

1. JUMPER PLACEMENT CHART

MODEL	432A	433A	434A		435A		442A	
	C139-109-1	C139-109-2	C139-109-3	C139-109-4	C139-109-5	C139-109-6	C139-109-7	
	POS	POS	NEG	POS	NEG	POS	POS	
	2N4403	2N4403	2N4401	2N4403	2N4401	2N4403	2N4403	
JUMPER PLACEMENT FROM	W TO V Y TO V Y TO K X TO Z S TO T J TO H D TO F B TO E M TO L N TO O BI TO CI	Y TO V W TO K X TO Z S TO T J TO H D TO F B TO E M TO L N TO O BI TO CI	W TO V W TO X Y TO K K TO Z U TO T J TO G D TO F B TO E N TO L P TO O BI TO CI	W TO V Y TO V Y TO K X TO Z S TO T J TO H D TO F B TO E M TO L N TO O BI TO AI	W TO V Z TO K X TO W U TO T J TO G D TO F B TO E N TO L P TO O CI TO BI	W TO V Y TO V Y TO K X TO Z S TO T J TO H D TO F B TO E M TO L N TO O BI TO AI	W TO V Y TO V Y TO K X TO Z S TO T J TO H D TO F B TO E M TO L N TO O CI TO BI	
	C139-109-1MP	C139-109-2MP	C139-109-3MP	C139-109-4MP	C139-109-5MP	C139-109-6MP	C139-109-7MP	
ON	A TO D B TO C	A TO D B TO C	A TO D B TO C	A TO D B TO C	A TO D B TO C	A TO D B TO C	A TO D B TO C	
REMOVE JUMPER FROM	F TO D E TO B	F TO D E TO B	F TO D E TO B	F TO D E TO B	F TO D E TO B	F TO D E TO B	F TO D E TO B	

2. UNLESS OTHERWISE SPECIFIED ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 5%. TRANSISTORS ARE NPN 2N4401 PNP 2N4403 DIODES ARE IN483B CAPACITOR VALUES ARE IN *uf*, 10%, 200V.

3. USED ON MP MODIFICATION ONLY.

4. REVERSE POLARITY FOR NEGATIVE REGULATORS.

5. SEE SPECIFIC PARTS LIST FOR VALUES AND USAGE.

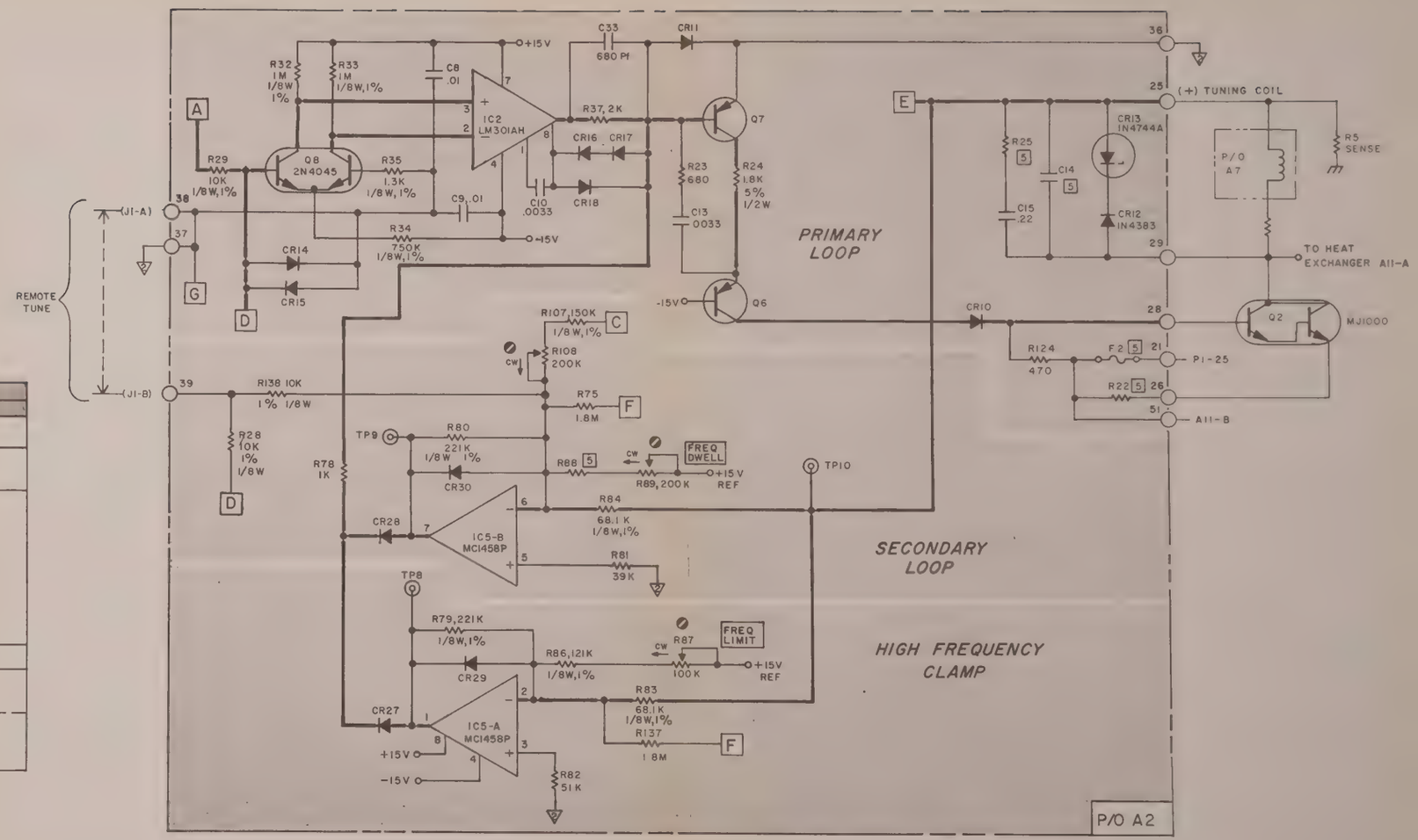


Figure 7-9. YIG Bias and Tuning Supply Assembly A2, Schematic Diagram (Sheet 2 of 3)

NOTES: *(CON'T)*

6. SYMBOL [A] DENOTES JUNCTION POINT BETWEEN MULTI SHEET CIRCUITS. SEE CHART BELOW.

CHART		
SYM	JUNCTION POINTS	FIG. No.
A	R133	
	R29	
B	R127	
	CR41 & R109	
C	Q18-C & R112	
	R107	
D	R51, R105 & C29	
	R28	
E	C29, C30 & R104	
	R83, R84, TP10 & C14	
	C15 & CR13	
F	R75	
	R137	
	R50 & R51	
G	CR14, CR15, C8, C9 & R35	
	R50, CR50, R129, CR25 R67, R62 & CR26	
H	R125 & C34	
	▽ GND POINT "C"	
J	Q20-E	
	POINT "A"	

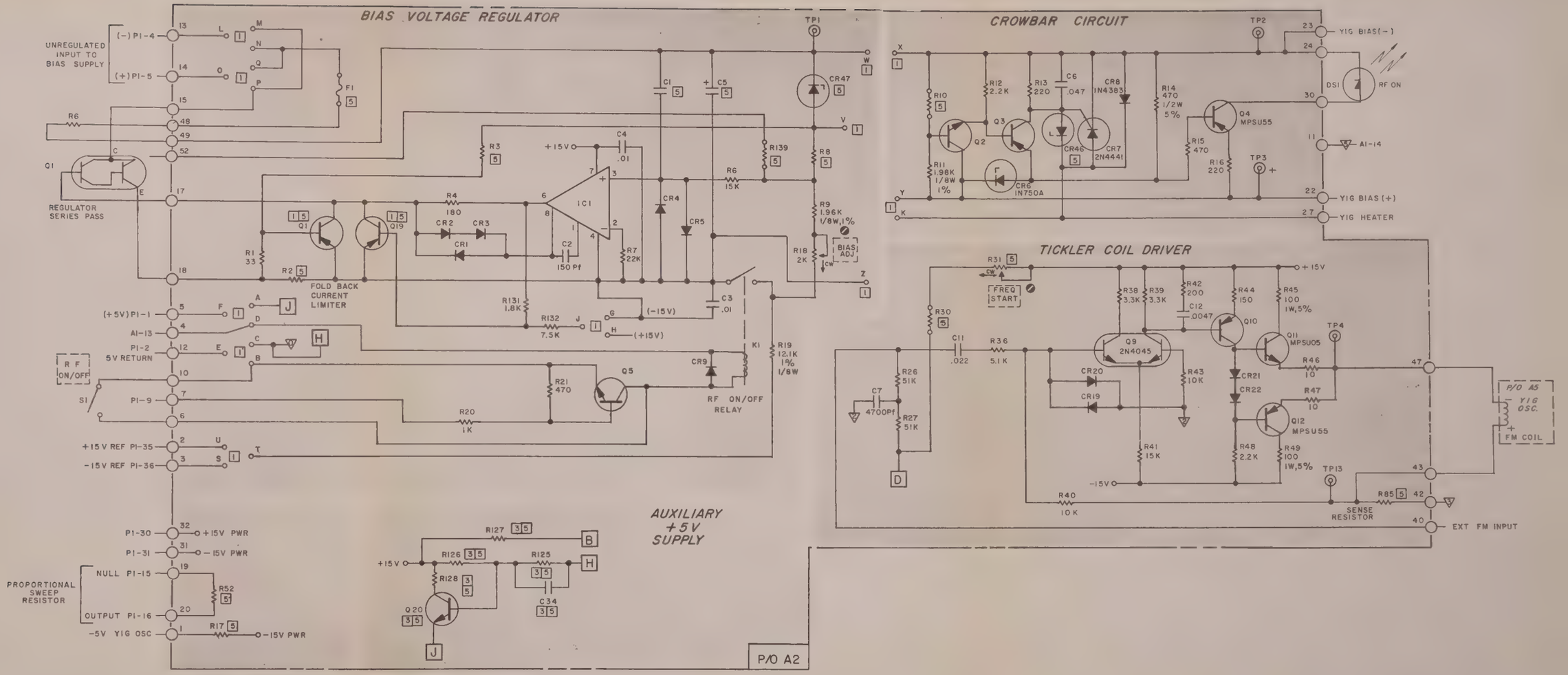
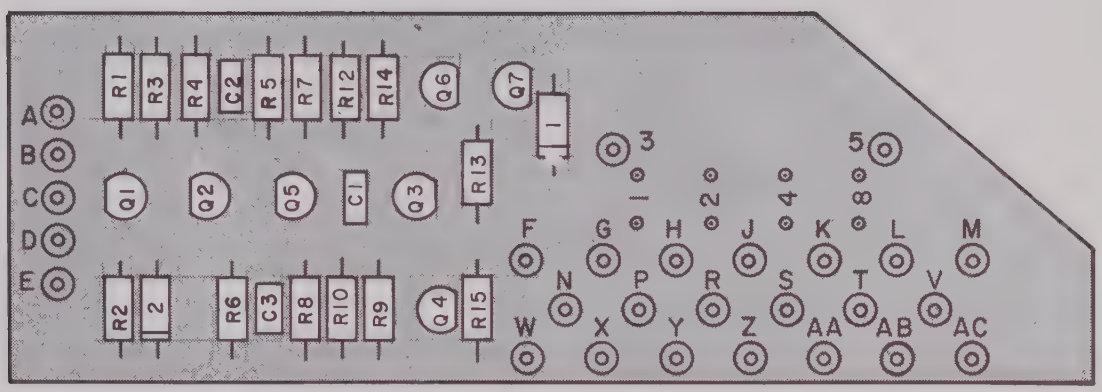


Figure 7-9. YIG Bias and Tuning Supply Assembly A2, Schematic Diagram (Sheet 3 of 3)



SYM. DES.

1. —[CR]— DIODE
2. ⊙ SOLDER TERM.
3. ⊙ SOLDER POINT

NOTE:

1. UNLESS OTHERWISE SPECIFIED ALL
   RESISTORS ARE IN OHMS, 1/4W, 5%
   TRANSISTORS ARE NPN 2N4401, PNP 2N4403

Figure 7-10. Auxiliary Reference Supply Assembly A3, Component Identification

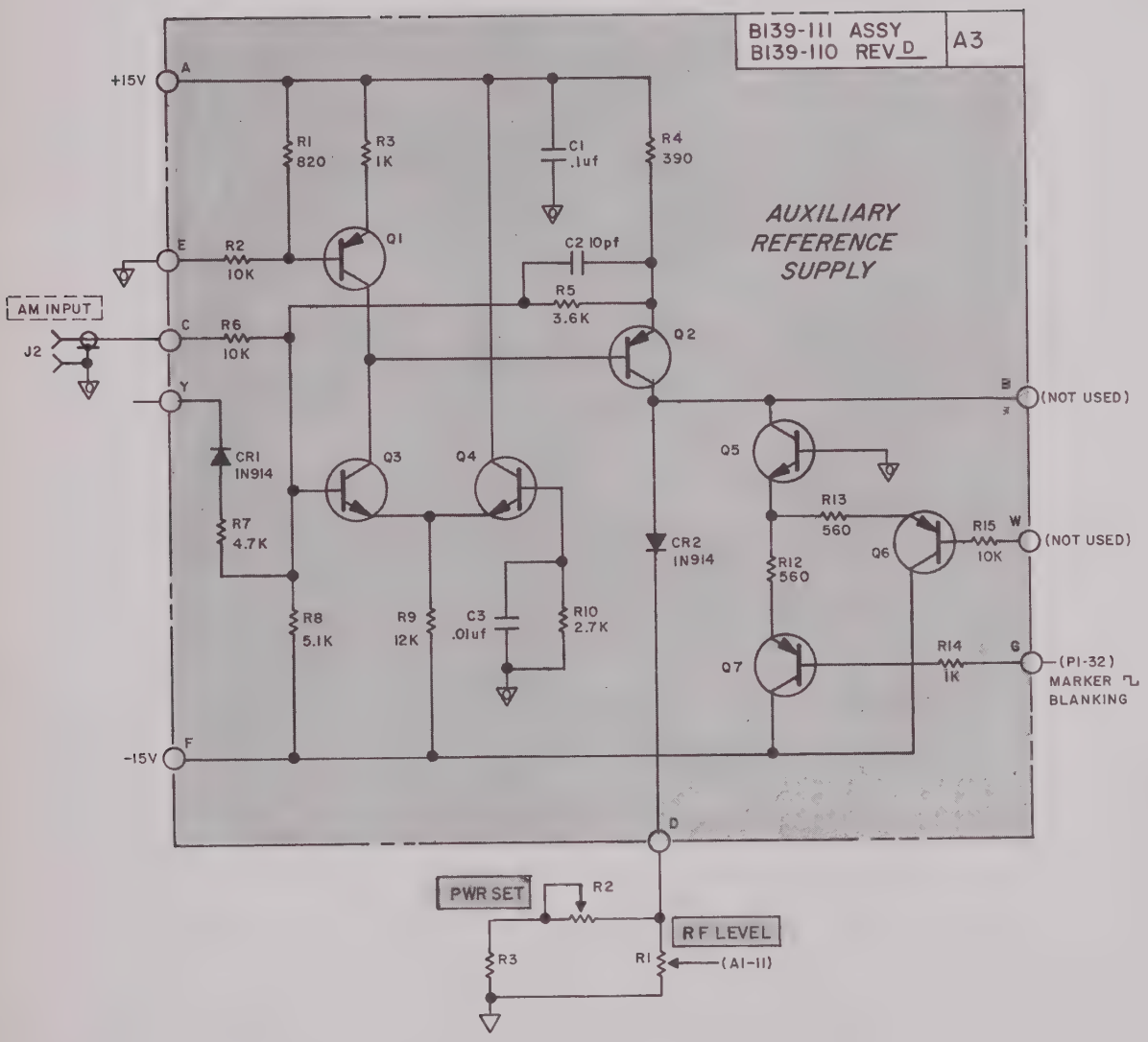


Figure 7-11. Auxiliary Reference Supply Assembly A3, Schematic Diagram

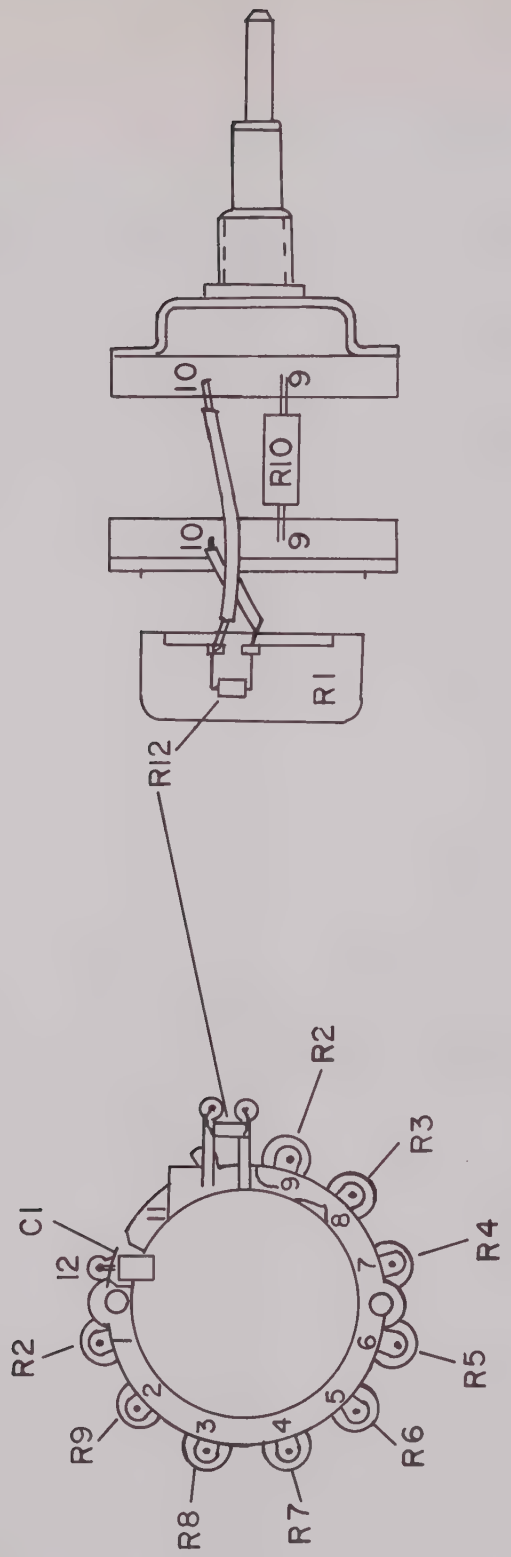
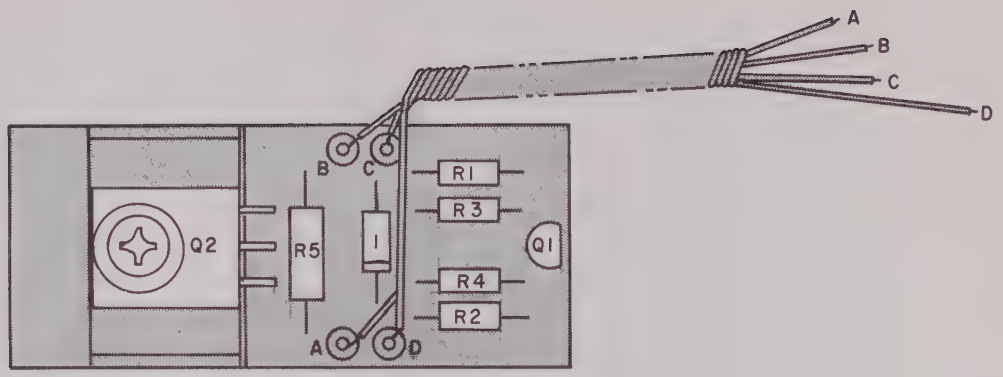


Figure 7-12. Symmetrical Sweep Oscillator Assembly A4, Wiring Diagram and Component Identification

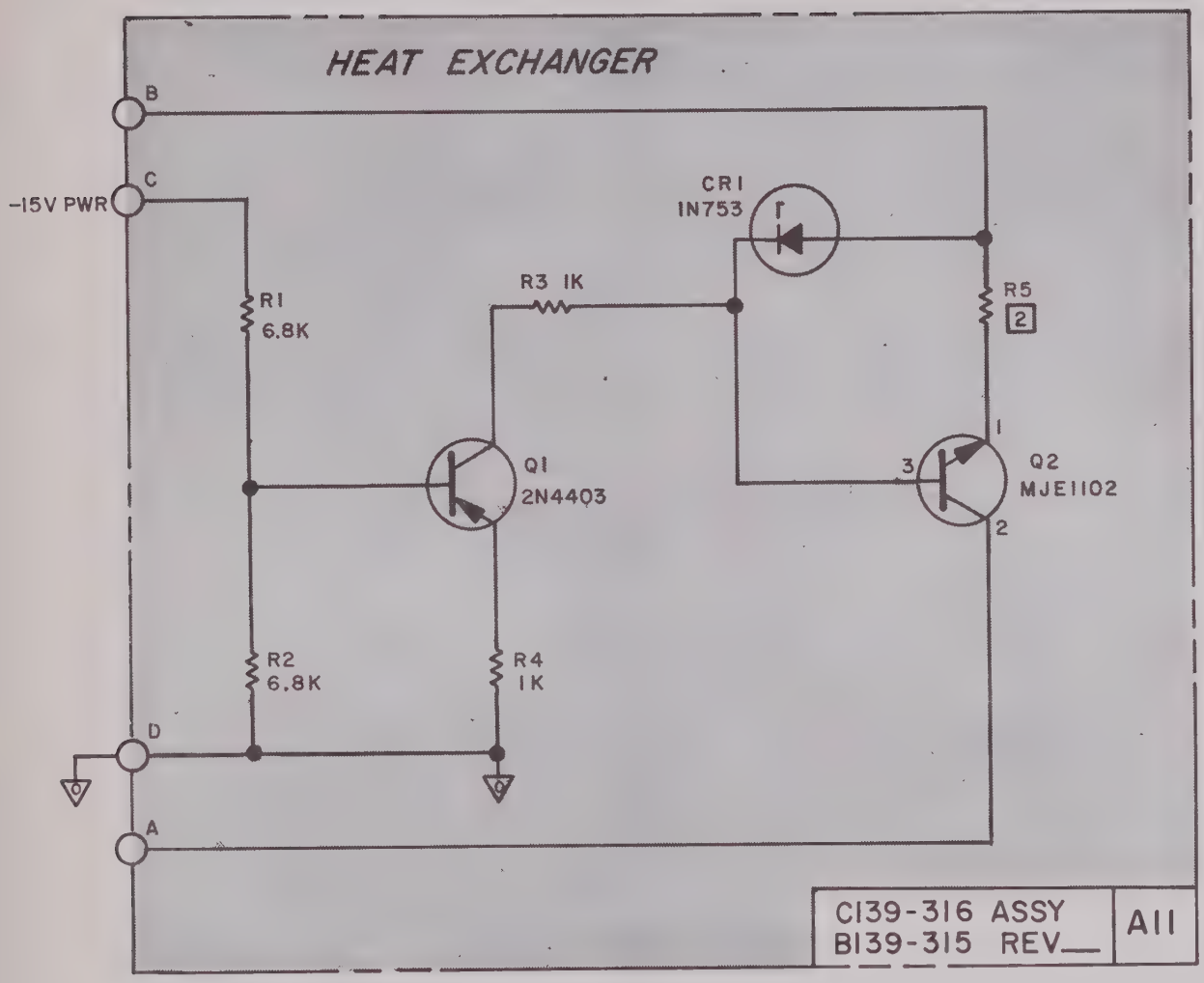


SYM. DES.

1. CR DIODE
2. SOLDER TERM.

MODEL 434A & 435A			
COLOR	WIRE	FROM	TO
W/RED	A	PIN A	Q2 COLLECTOR
BLUE	B	PIN B	A2R22/F2
VIO	C	PIN C	A3-F
BLACK	D	PIN D	R5-2

Figure 7-13. Heat Exchanger Assembly A11, Component Identification

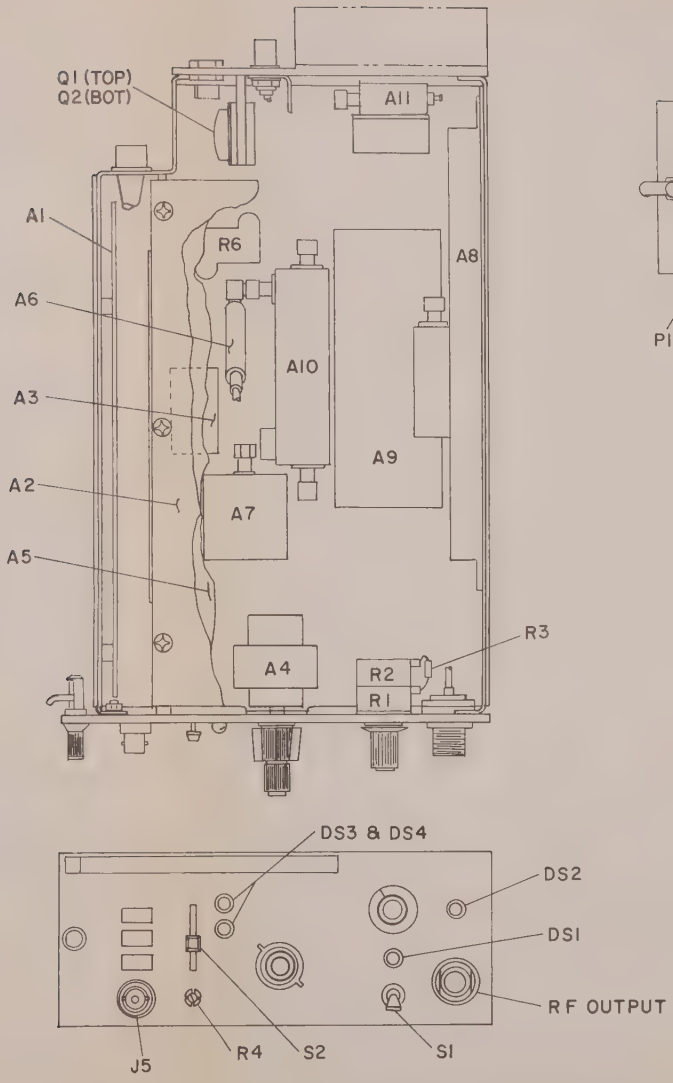


NOTE:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE IN OHMS, 1/4W, 5%

[2] SEE SPECIFIC PARTS LIST FOR VALUE AND USAGE.

Figure 7-14. Heat Exchanger Assembly A11, Schematic Diagram



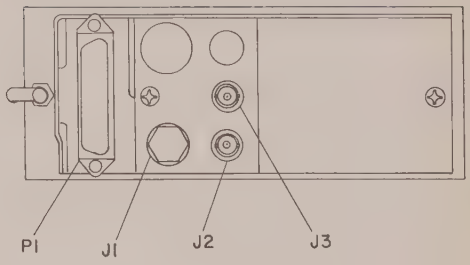


Figure 7-15. Model 438A-1 (OM) YIG Tuned RF Unity, Assembly and Component Identification

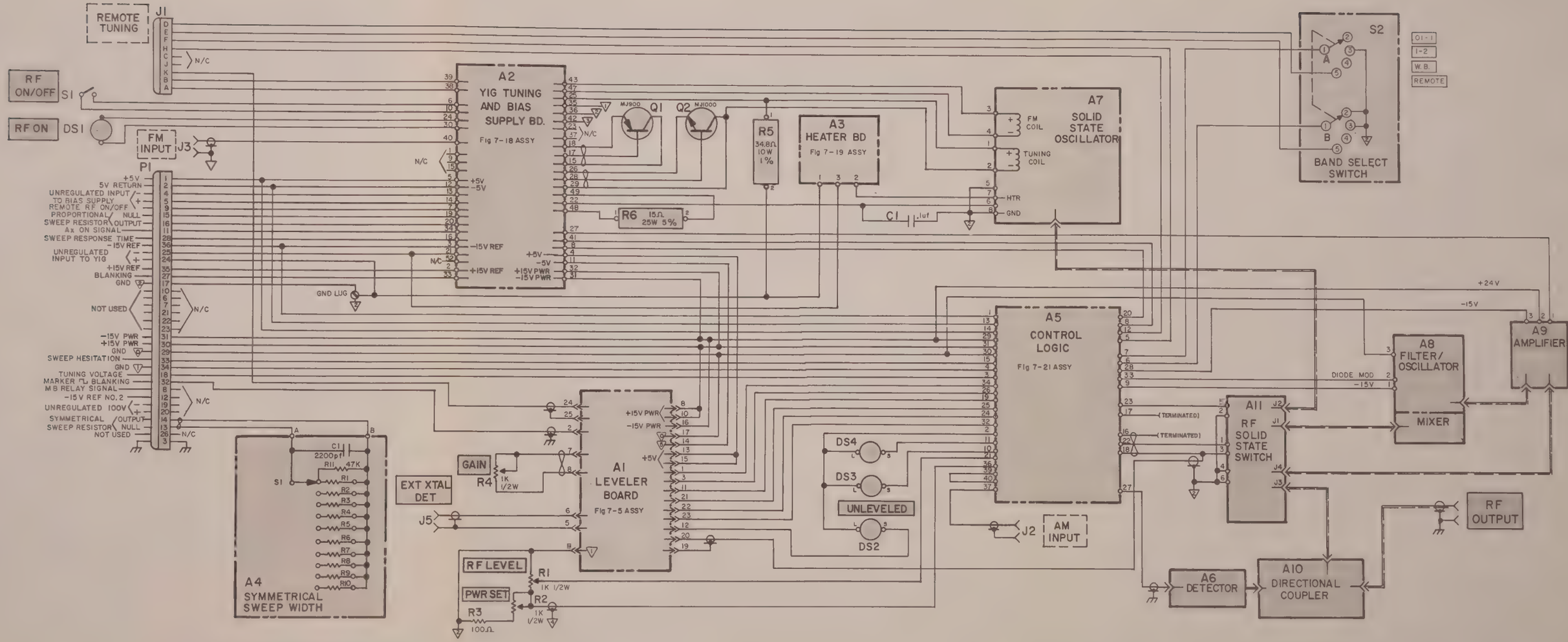


Figure 7-16. Model 438A-1(OM) YIG Tuned RF Unit, Overall Schematic Diagram

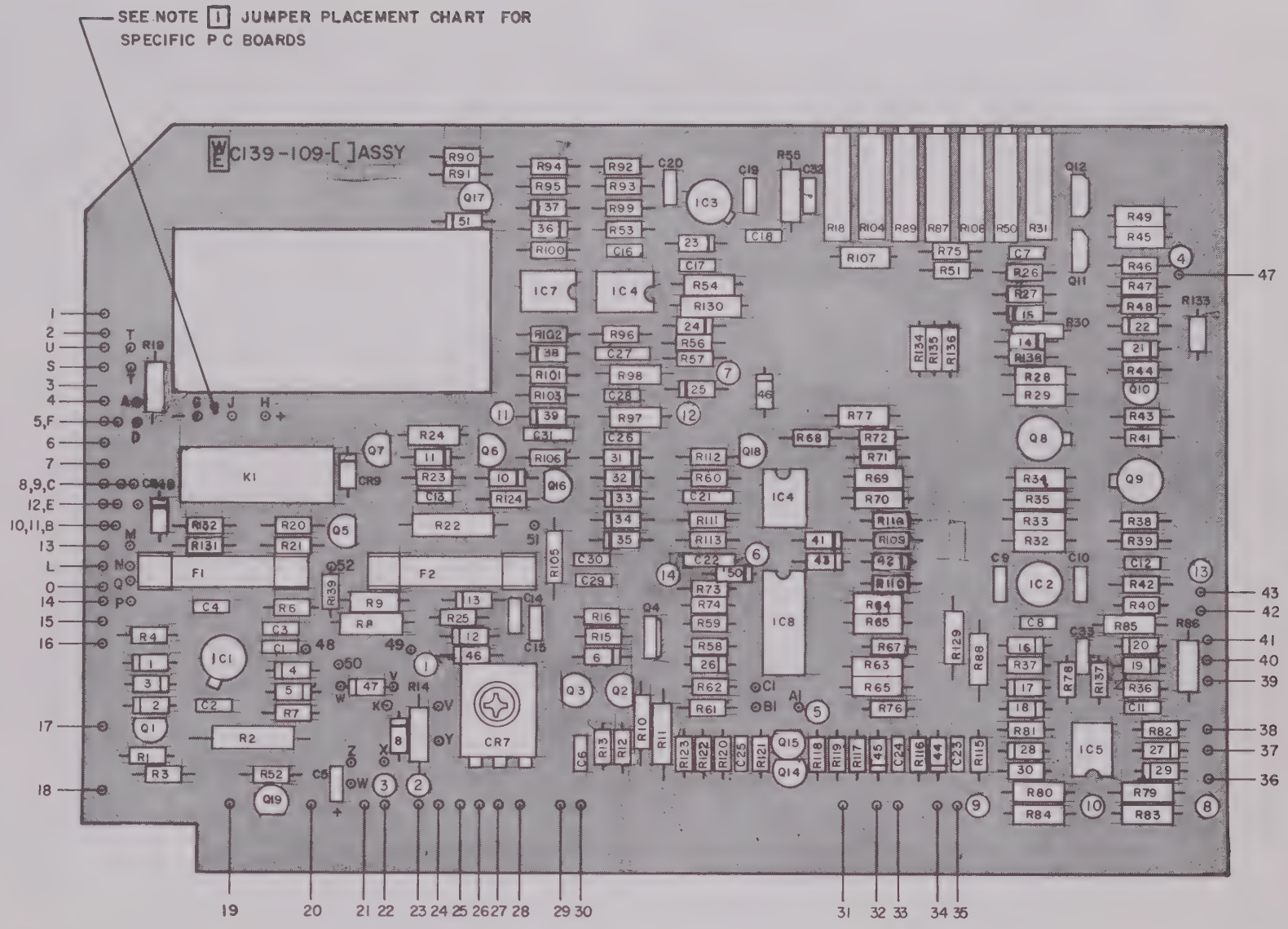


Figure 7-17. Model 438A-1 (OM), Bias and Tuning Supply Assembly A2, Component Identification

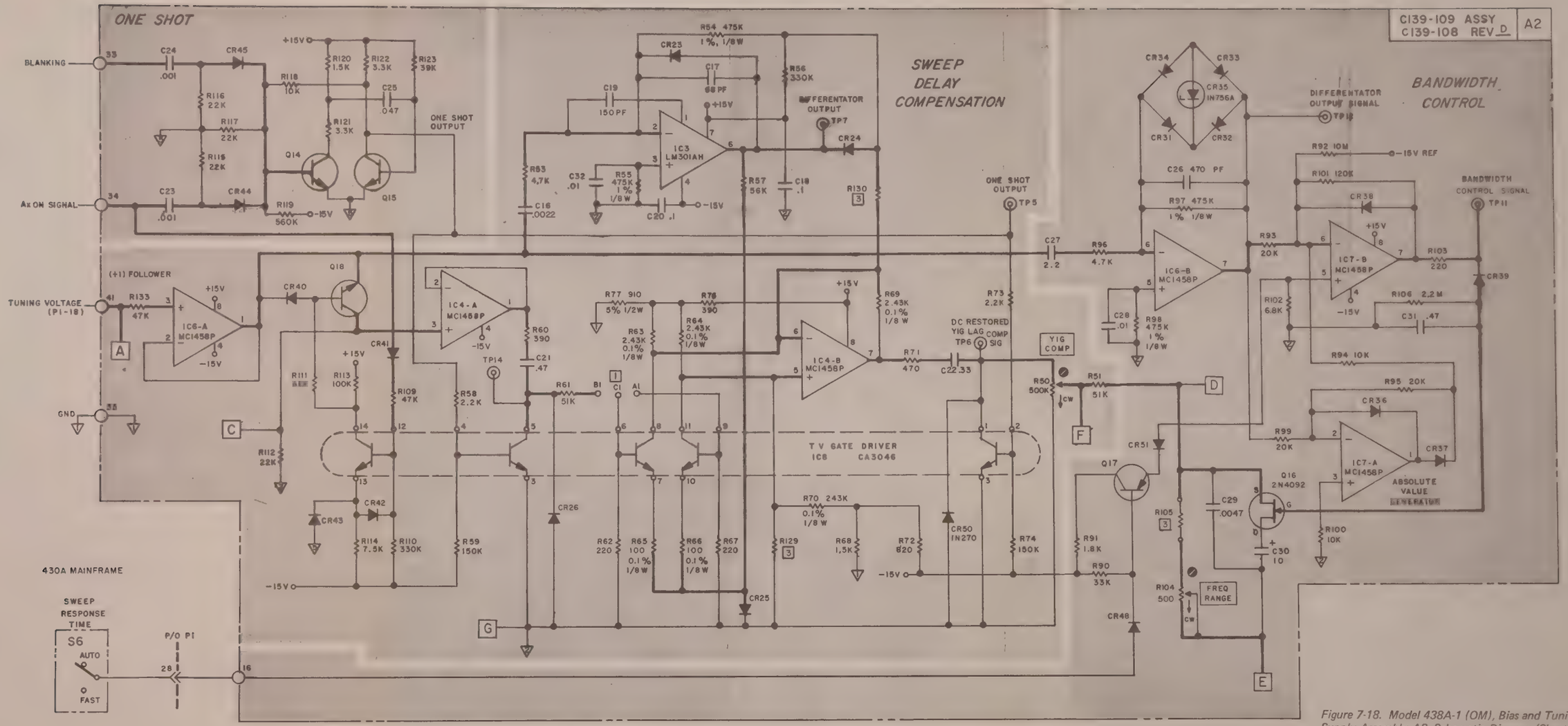


Figure 7-18. Model 438A-1 (OM), Bias and Tuning Supply Assembly A2, Schematic Diagram (Sheet 1 of 3)

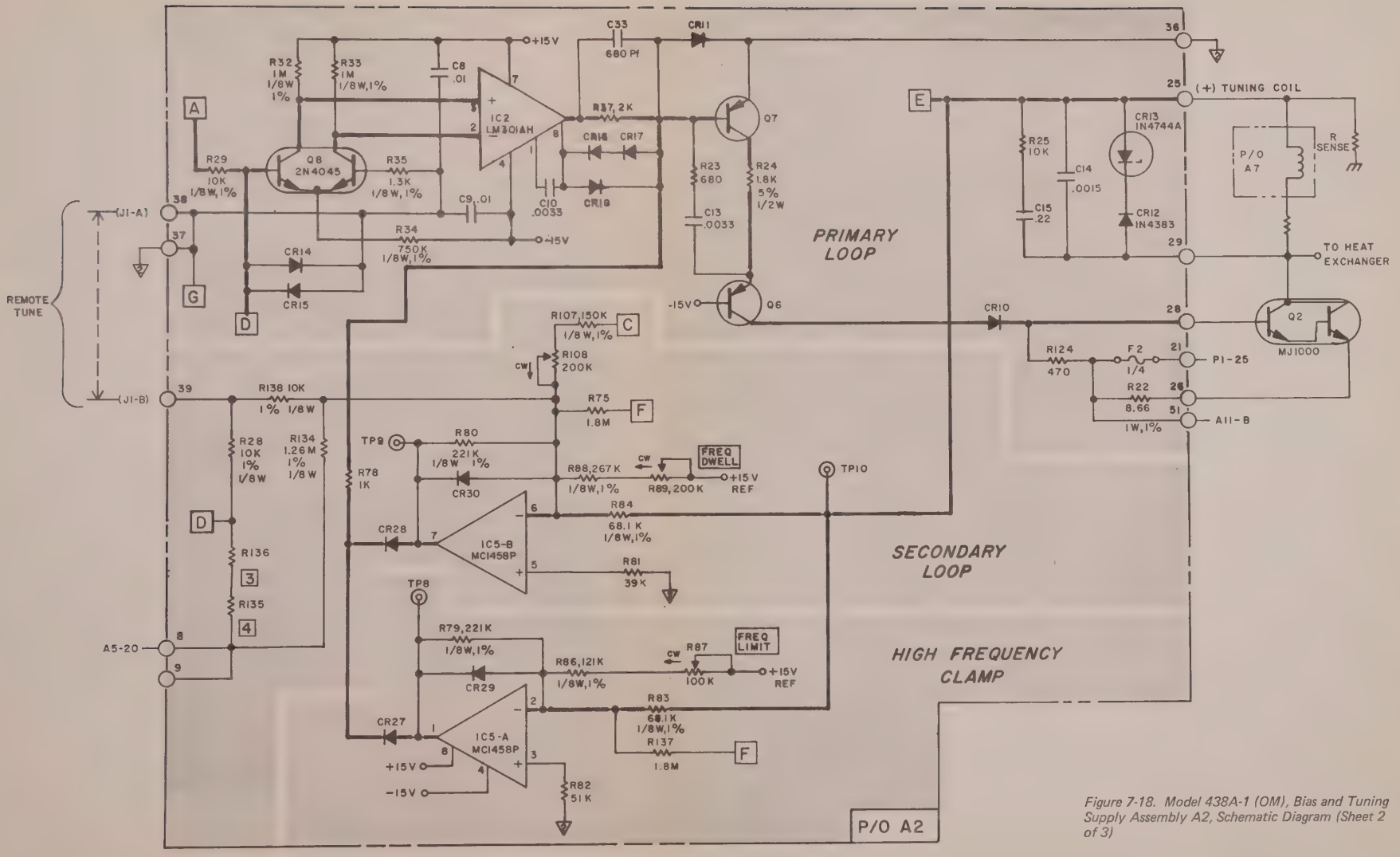


Figure 7-18. Model 438A-1 (OM), Bias and Tuning Supply Assembly A2, Schematic Diagram (Sheet 2 of 3)

4. SYMBOL [A] DENOTES JUNCTION POINT BETWEEN MULTI-SHEET CIRCUITS. SEE CHART BELOW.

CHART		
SYM	JUNCTION POINTS	FIG. No.
[A]	R133	
	R29	
[ ]		
[C]	Q18-C & R112	
	R107	
[D]	R51, R105 & C29	
	R28	
[E]	C29, C30 & R104	
	R83, R84, TP10 & C14	
	C15 & CR13	
[F]	R75	
	R137	
	R50 & R51	
[G]	CR14, CR15, C8, C9 & R35	
	R50, CR50, R129, CR25 R67, R62 & CR26	

NOTES:

[1] JUMPER PLACEMENT CHART

MODEL		438A(OM)
		C139-109-8
TYPE REGULATOR		POS
TYPE TRANSISTOR Q1 / Q19		2N4403
JUMPER PLACEMENT FROM		W TO K Y TO V X TO Z S TO T J TO H D TO F B TO E M TO L Q TO O B1 TO C1

2. UNLESS OTHERWISE SPECIFIED ALL

RESISTOR VALUES ARE IN OHMS, 1/4 W, 5%.
TRANSISTORS ARE NPN 2N4401
PNP 2N4403
DIODES ARE IN483B
CAPACITOR VALUES ARE IN *uf*, 10%, 200V.

[3]. VALUES SELECTED AT TEST.

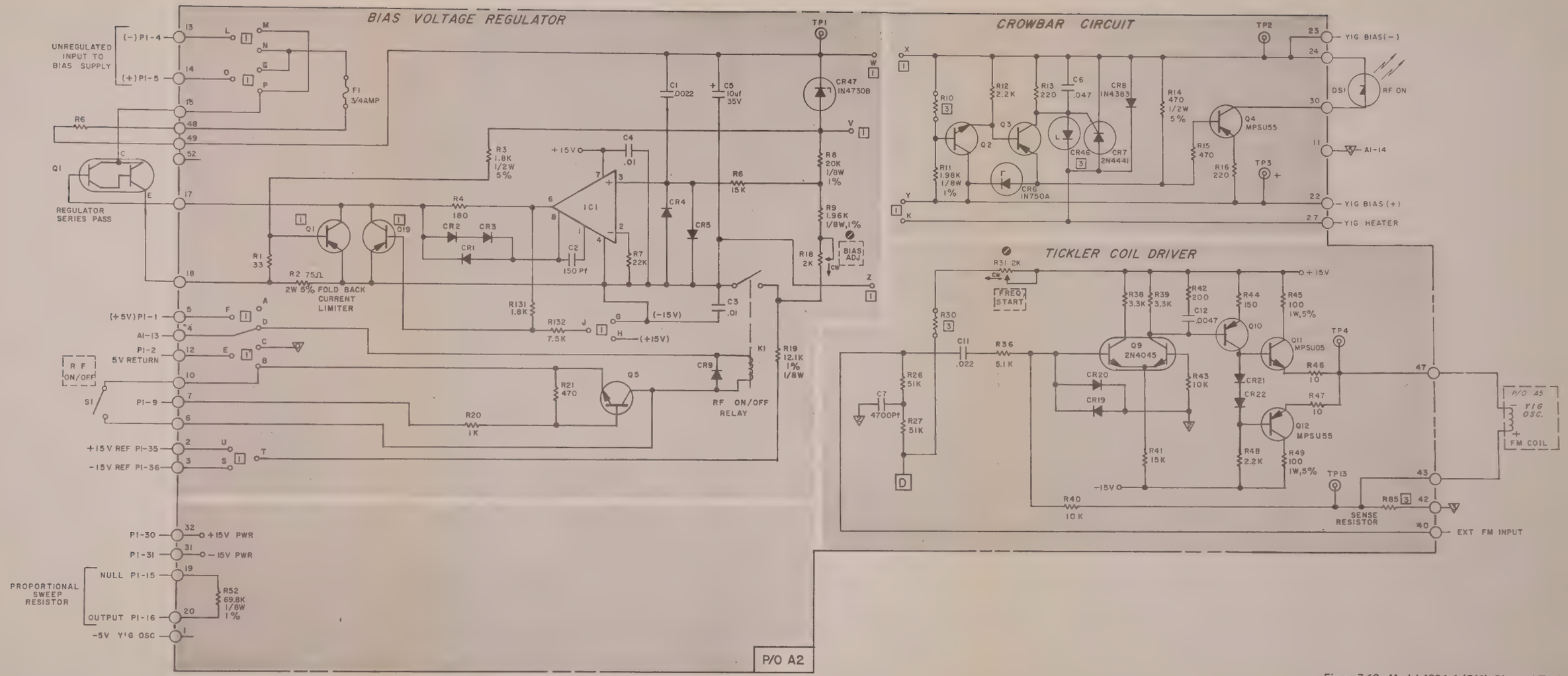
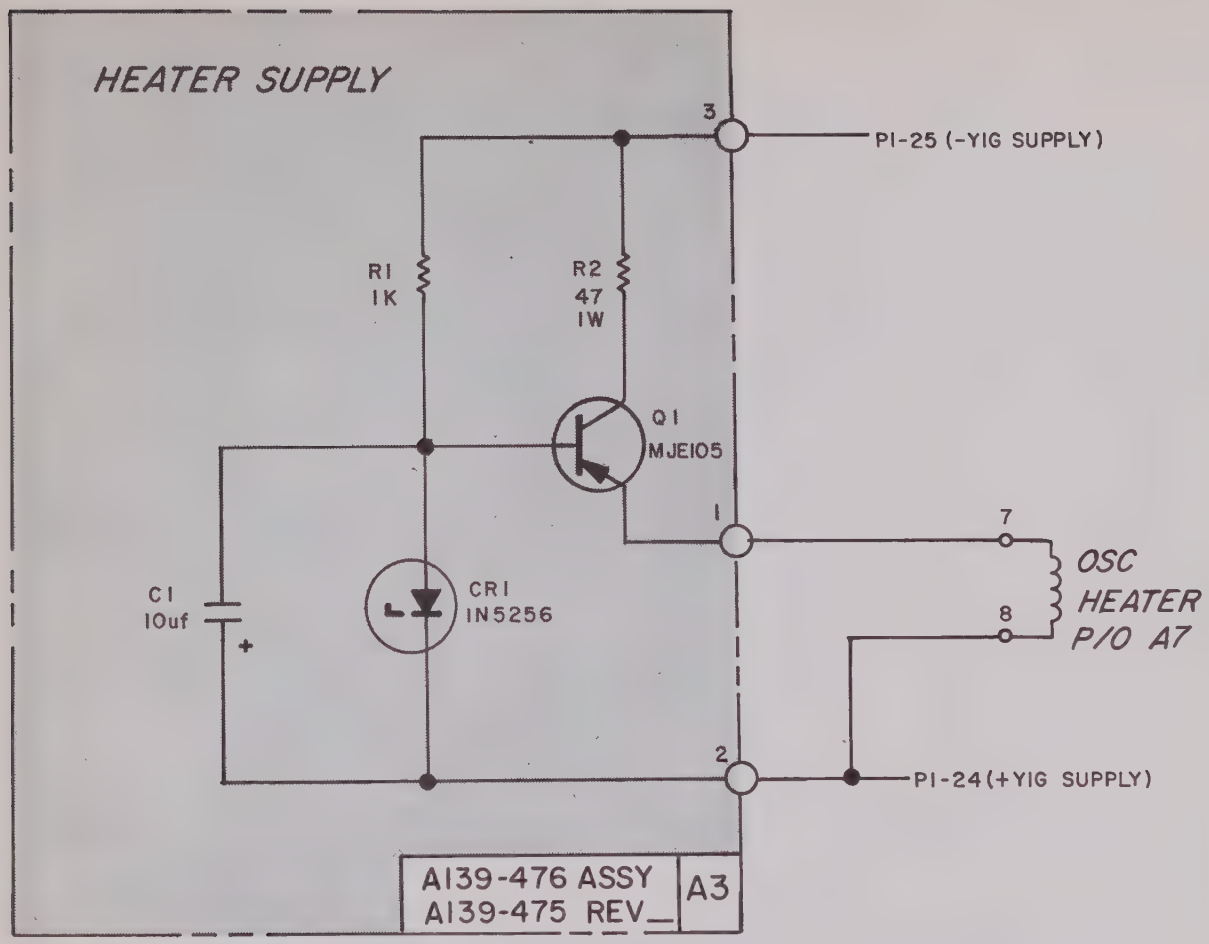
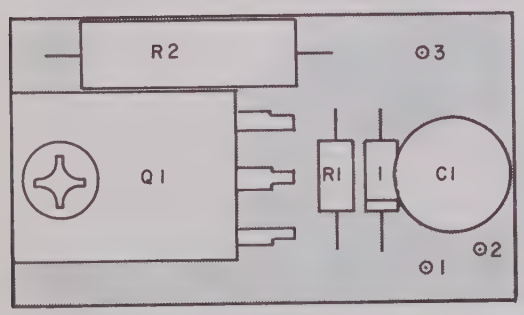


Figure 7-18. Model 438A-1 (OM), Bias and Tuning Supply Assembly A2, Schematic Diagram (Sheet 3 of 3)





SYM. DES.

1. CR DIODE
2. ⊙ SOLDER POINT

NOTE:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE IN OHMS, 1/4W, 5%

Figure 7-19. Model 438A-1 (OM), Auxiliary Reference Supply Assembly A3, Schematic Diagram and Component Identification

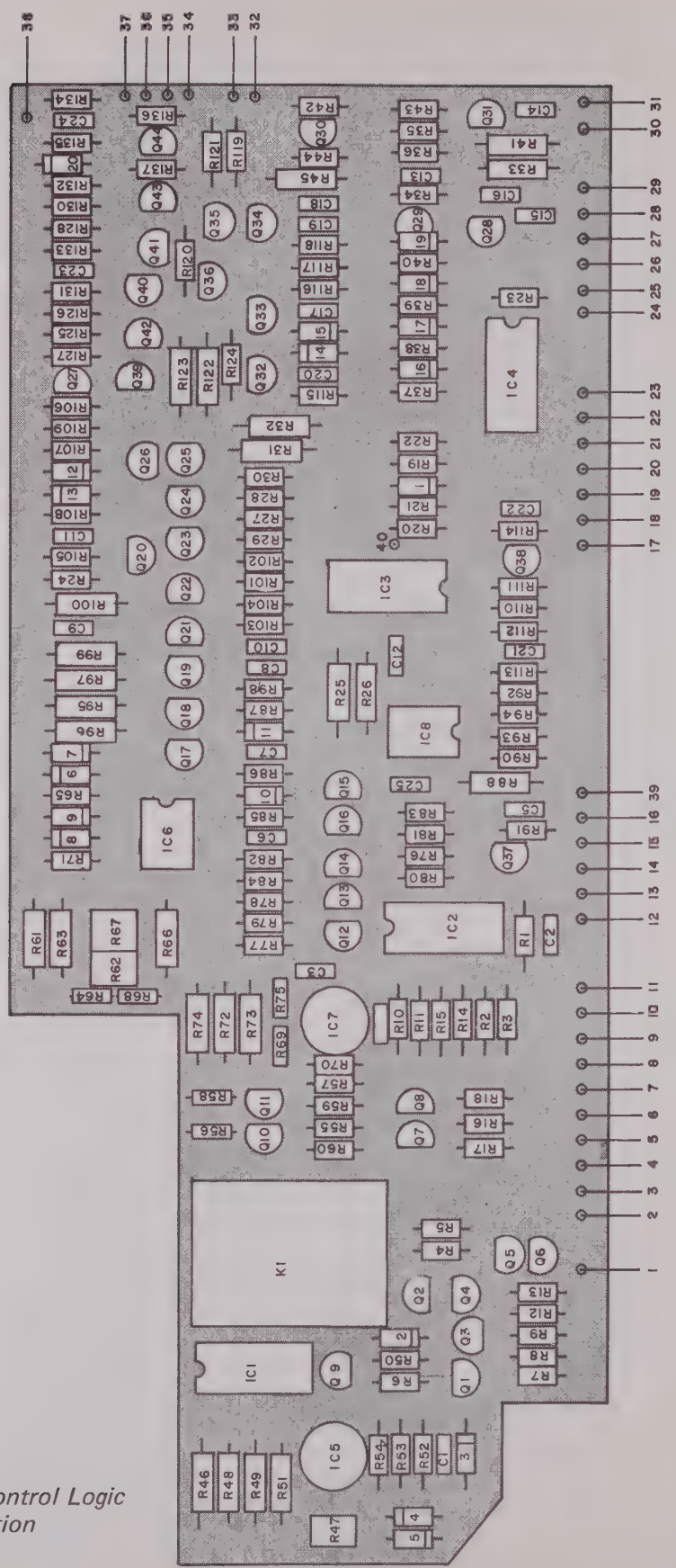


Figure 7-20. Model 438A-1 (OM), Control Logic Assembly A5, Component Identification

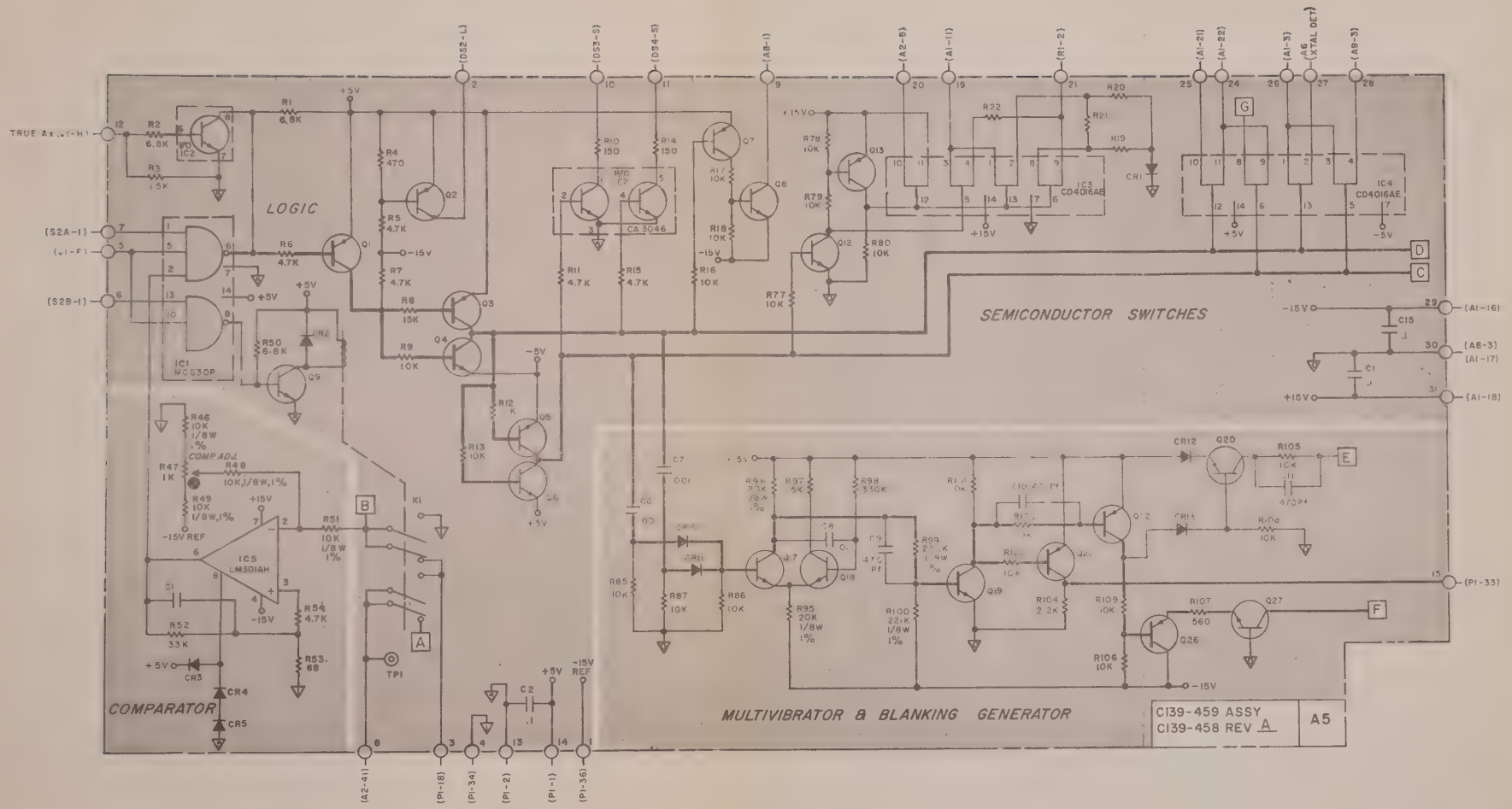


Figure 7-21. Model 438A-1 (OM), Control Logic Assembly A5, Schematic Diagram (Sheet 1 of 2)

NOTES:

[1]. UNLESS OTHERWISE SPECIFIED ALL
RESISTORS VALUE ARE IN OHMS, 5%, 1/4W
CAPACITOR VALUES ARE IN μf
DIODES ARE IN914A
TRANSISTORS ARE NPN 2N4401, PNP 2N4403

[2]. SEE SPECIFIC PARTS LIST FOR VALUES AND USAGE.

3. SYMBOL [A] DENOTES JUNCTION POINT BETWEEN MULTI SHEET CIRCUITS.

SYM	JUNCTION POINTS	FIG NO.
A	K1	
	IC7-6, C3, R69	
B	K1	
	R56, R58	
C	IC4-5, IC4-6	
	R59, R76	
D	IC4-12, IC4-13	
	R24, R60	
E	R105, C11	
	R24, IC2-12	
F	Q27-COLLECTOR	
	Q42 & Q43-COL	
G	IC4-8	
	R34, R35, C13	

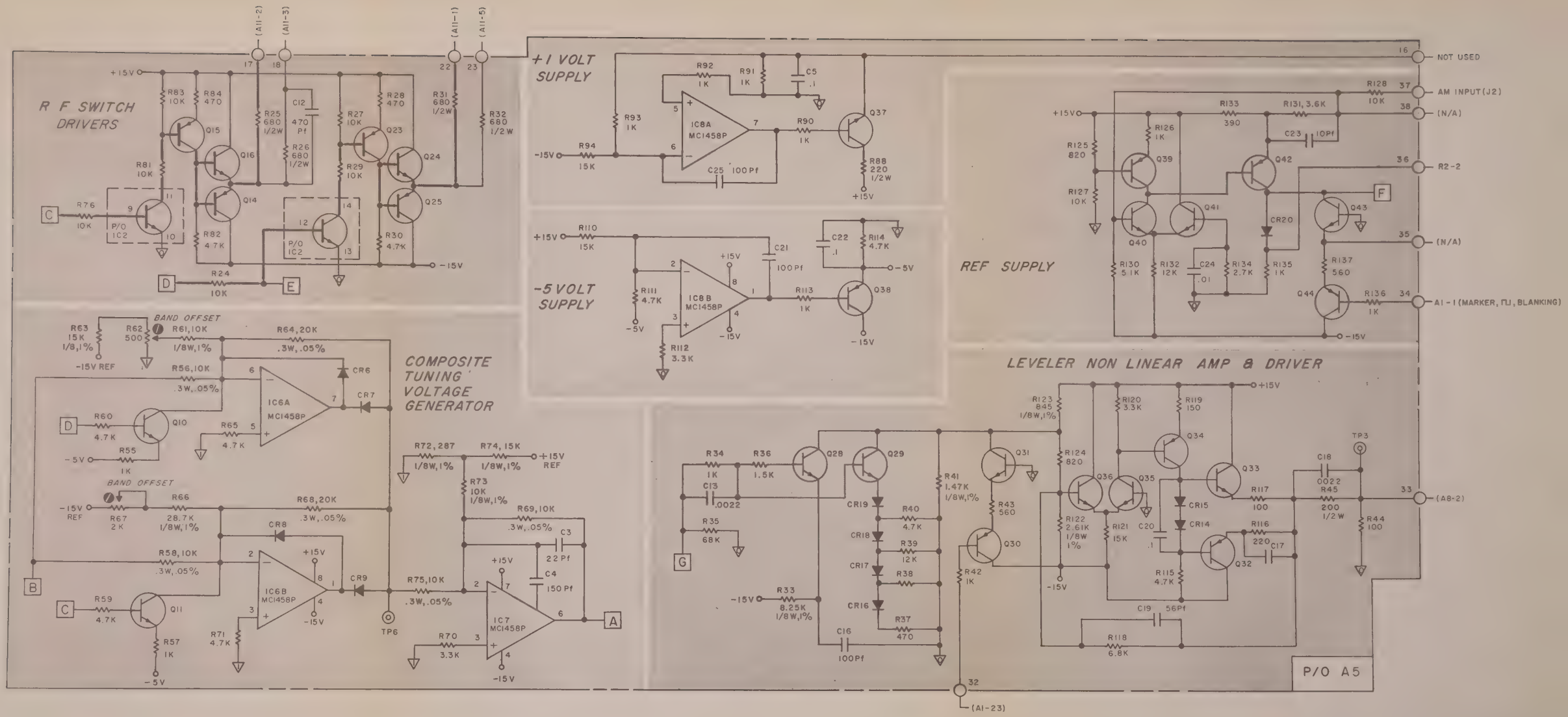


Figure 7-21. Model 438A-1 (OM), Control Logic Assembly A5, Schematic Diagram (Sheet 2 of 2)

CODE LIST OF MANUFACTURERS

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 Handbooks.

Code No.	Manufacturer/Address
00000	U.S.A. Common: Any supplier of U.S.
00136	McCoy Electronics: Mount Holly Springs, Pa.
00213	Sage Electronics Corp.: Rochester, N.Y.
00287	Cemco Inc.: Danielson, Conn.
00334	Humidial: Colton, Calif.
00348	Microtron Co., Inc.: Valley Stream, N.Y.
00373	Garlock Inc.: Cherry Hill, N.J.
00656	Aerovox Corp.: New Bedford, Mass.
00779	Amp. Inc.: Harrisburg, Pa.
00781	Aircraft Radio Corp.: Boonton, N.J.
00815	Northern Engineering Laboratories, Inc.: Burlington, Wis.
00853	Sangamo Electric Co., Pickens Div.: Pickens, S.C.
00866	Goe Engineering Co.: City of Industry, Calif.
00891	Carl F. Holmes Corp.: Los Angeles, Calif.
00929	Microlab Inc.: Livingston, N.J.
01002	General Electric Co., Capacitor Dept.: Hudson Falls, N.Y.
01009	Alden Products Co.: Brockton, Mass.
01121	Allen Bradley Co.: Milwaukee, Wis.
01255	Litton Industries, Inc.: Beverly Hills, Calif.
01281	TRW Semiconductors, Inc.: Lawndale, Calif.
01295	Texas Instruments, Inc., Transistor Products Div.: Dallas, Texas
01349	The Alliance Mfg. Co.: Alliance, Ohio
01589	Pacific Relays, Inc.: Van Nuys, Calif.
01670	Gudebrod Bros, Silk Co.: New York, N.Y.
01884	Sprague: Longwood, Fla.
01930	Amerock Corp.: Rockford, Ill.
01961	Pulse Engineering Co. : Santa Clara, Calif.
02114	Ferroxcube Corp. of America: Saugerties, N.Y.
02116	Wheelock Signals, Inc.: Long Branch, N.J.
02286	Cole Rubber and Plastics Inc.: Sunnyvale, Calif.
02660	Amphenol-Borg Electronics Corp.: Broadview, Ill.
02735	Radio Corp. of America, Semiconductor and Materials Div.: Somerville, N.J.
02771	Vocaline Co. of America, Inc.: Old Saybrook, Conn.
02777	Hopkins Engineering Co.: San Fernando, Calif.
02875	Hudson Tool & Die Co.: Newark, N.J.
03508	G. E. Semiconductor Prod. Dept.: Syracuse, N.Y.
03705	Apex Machine & Tool Co.: Dayton, Ohio
03797	Eldema Corp.: Compton, Calif.
03818	Parker Seal Co.: Los Angeles, Calif.
03877	Transitron Electric Corp.: Wakefield, Mass.
03888	Pyrofilm Resistor Co., Inc.: Cedar Knolls, N.J.
03954	Singer Co., Diehl Div. Finderne Plant: Sumerville, N.J.
04009	Arrow, Hart and Hegeman Elect. Co.: Hartford, Conn.
04013	Taurus Corp.: Lambertville, N.J.
04062	Arco Electronic Inc.: Great Neck, N.Y.
04222	Hi-Q Division of Aerovox: Myrtle Beach, S.C.
04354	Precision Paper Tube Co.: Wheeling, Ill.
04404	Dymec Division of Hewlett-Packard Co.: Palo Alto, Calif.
04651	Sylvania Electric Products, Microwave Device Div.: Mountain View, Calif.
04673	Dakota Engr. Inc.: Culver City, Calif.
04713	Motorola, Inc., Semiconductor Prod. Div.: Phoenix, Arizona
04732	Filtron Co., Inc. Western Div.: Culver City, Calif.
04773	Automatic Electric Co.: Northlake, Ill.
04796	Sequoia Wire Co.: Redwood City, Calif.
04811	Precision Coil Spring Co. : El Monte, Calif.
04870	P. M. Motor Company: Westchester, Ill.
04919	Component Mfg. Service Co.: W. Bridgewater, Mass.
05006	Twentieth Century Plastics, Inc.: Los Angeles, Calif.
05245	Components Corp.: Chicago, Ill.
05277	Westinghouse Electric Corp., Semi-Conductor Dept. Youngwood, Pa.
05347	Ultronix, Inc.: San Mateo, Calif.
05397	Union Carbide Corp., Elect. Div.: New York, N.Y.
05574	Viking Ind. Inc.: Canoga Park, Calif.
05593	Icore Electro-Plastics Inc.: Sunnyvale, Calif.
05616	Cosmo Plastic (c/o Electrical Spec. Co.): Cleveland, Ohio
05624	Barber Colman Co.: Rockford, Ill.
05728	Tiffen Optical Co.,: Roslyn Heights, Long Island, N.Y.
05729	Metro-Tel Corp.: Westbury, N.Y.
05783	Stewart Engineering Co.: Santa Cruz, Calif.
05820	Wakefield Engineering Inc.: Wakefield, Mass.
06004	Bassick Co., Div. of Stewart Warner Corp.: Bridgeport, Conn.
06090	Raychem Corp.: Redwood City, Calif.
06175	Bausch and Lomb Optical.: Rochester, N.Y.
06402	E.T.A. Products Co. of America: Chicago, Ill.
06540	Amatom Electronic Hardware Co., Inc.: New Rochelle, N.Y.
06555	Beede Electrical Instrument Co., Inc.: Penacook, N.H.
06666	General Devices Co., Inc.: Indianapolis, Ind.
06751	Components Inc., Ariz. Div.: Phoenix, Ariz.
06812	Torrington Mfg. Co., West Div.: Van Nuys, Calif.
06980	Varian Assoc. Eimac Div.: San Carlos, Calif.
07088	Kelvin Electric Co.: Van Nuys, Calif.
07126	Digitran Co.: Pasadena, Calif.
07137	Transistor Electronics Corp.: Minneapolis, Minn.
07138	Westinghouse Electric Corp., Electronic Tube Div.: Elmira, N.Y.
07149	Filmohm Corp.: New York, N.Y.
07233	Cinch-Graphik Co.: City of Industry, Calif.
07256	Silicon Transistor Corp.: Carle Place, N.Y.
07261	Avnet Corp.: Culver City, Calif.
07263	Fairchild Camera & Inst. Corp, Semiconductor Div.: Mountain View, Calif.
07322	Minnesota Rubber Co.: Minneapolis, Minn.
07387	Birtcher Corp., The: Monterey Park, Calif.
07397	Sylvania Elect. Prod. Inc.,: Mt. View Operations: Mountain View, Calif.
07700	Technical Wire Products Inc.: Cranford, N. J.
07829	Bodine Elect. Co.: Chicago, Ill.

LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer/Address
07910	Continental Device Corp.: Hawthorne, Calif.
07933	Raytheon Mfg. Co., Semiconductor Div.: Mountain View, Calif.
07980	Hewlett-Packard Co., Boonton Radio Div.: Rockaway, N.J.
08145	U.S. Engineering Co.: Los Angeles, California
08289	Blinn, Delbert Co.: Pomona, Calif.
08358	Burgess Battery Co.: Niagara Falls, Ontario, Canada
08524	Deutsch Fastener Corp.: Los Angeles, Calif.
08664	Bristol., The: Waterbury, Conn.
08717	Sloan Company: Sun Valley, Calif.
08718	ITT Cannon Electric Inc., Phoenix Div.: Phoenix, Arizona
08727	National Radio Lab. Inc.: Paramus, N.J.
08792	CBS Electronics Semiconductor Operations, Div. of C. B. S. Inc.: Lowell, Mass.
08806	General Electric Co. Miniat. Lamp Dept.: Cleveland, Ohio
08984	Mel-Rain: Indianapolis, Ind.
09021	Airco Speer: Bedford, Pa.
09026	Babcock Relays Div.: Costa Mesa, Calif.
09134	Texas Capacitor Co.: Houston, Texas
09145	Tech. Ind. Inc. Atohm Elect.: Burbank, Calif.
09250	Electro Assemblies, Inc.: Chicago, Ill.
09353	C & K Components Inc.: Newton, Mass.
09569	Mallory Battery Co. of Canada, Ltd.: Toronto, Ontario, Canada
09922	Burndy Corp.: Norwalk, Conn.
09969	Dale: Yankgon, S.D.
10214	General Transistor Western Corp.: Los Angeles, Calif.
10411	Ti-Tal, Inc.: Berkeley, Calif.
10646	Carborundum Co.: Niagara Falls, N.Y.
11236	CTS of Berne, Inc.: Berne, Ind.
11237	Chicago Telephone of California, Inc.: So. Pasadena, Calif.
11242	Bay State Electronics Corp.: Waltham, Mass.
11312	Teledyne Inc., Microwave Div.: Palo Alto, Calif.
11314	National Seal: Downey, Calif.
11453	Precision Connector Corp.: Jamaica, N.Y.
11534	Duncan Electronics Inc.: Costa Mesa, Calif.
11711	General Instrument Corp., Semiconductor Div., Products Group: Newark, N.J.
11717	Imperial Electronic, Inc.: Buena Park, Calif.
11870	Melabs, Inc.: Palo Alto, Calif.
12040	National Semiconductor: Danbury, Conn.
12136	Philadelphia Handle Co.: Camden, N.J.
12300	Potter and Brumfield: Ontario, Canada
12361	Grove Mfg. Co., Inc.: Shady Grove, Pa.
12574	Gulton Ind. Inc. Data System Div.: Albuquerque, N.M.
12697	Clarostat Mfg. Co.: Dover, N.H.
12728	Elmar Filter Corp.: W. Haven, Conn.
12859	Nippon Electric Co., Ltd.: Tokyo, Japan
12881	Metex Electronics Corp.: Clark, N.J.
12930	Delta Semiconductor Inc.: Newport Beach, Calif.
12954	Dickson Electronics Corp.: Scottsdale, Arizona
13103	Thermolloy: Dallas, Texas
13396	Telefunken (GmbH): Hanover, Germany
13511	Amphenol: Gatos, Calif.
13835	Midland-Wright Div. of Pacific Industries, Inc.: Kansas City, Kansas
14099	Sem-Tech: Newbury Park, Calif.
14193	Calif. Resistor Corp.: Santa Monica, Calif.
14298	American Components, Inc.: Conshohocken, Pa.
14433	ITT Semiconductor, A Div. of Int. Telephone & Telegraph Corp.: West Palm Beach, Fla.
14493	Hewlett-Packard Company: Loveland, Colo.
14655	Cornell Dublier Electric Corp.: Newark, N.J.
14674	Corning Glass Works: Corning, N.Y.
14752	Electro Cube Inc.: San Gabriel, Calif.
14960	Williams Mfg. Co: San Jose, Calif.
15203	Webster Electronics Co.: New York, N.Y.
15287	Scionics Corp.: Northridge, Calif.
15291	Adjustable Bushing Co.: N. Hollywood, Calif.
15556	Micron Electronics: Garden City, Long Island, N.Y.
15566	Amprobe Inst. Corp.: Lynbrook, N.Y.
15631	Cabletronics: Costa Mesa, Calif.
15772	Twentieth Century Coil Spring Co.,: Santa Clara, Calif
15801	Fenwal Elect. Inc.: Framingham, Mass.
15818	Amelco Inc.: Mt. View, Calif.
16037	Spruce Pine Mica Co.: Spruce Pine, N.C.
16179	Omni-Spectra Inc.: Farmington, Mich.
16352	Computer Diode Corp.: Lodi, N.J.
16585	Boots Aircraft Nut Corp.: Pasadena, Calif.
16688	Ideal Prec. Meter Co., Inc. De Jur Meter Div.: Brooklyn, N.Y.
16758	Delco Radio Div. of G. M. Corp.: Kokoma, Ind
17109	Thermonetics Inc.: Canoga Park, Calif.
17474	Tranex Company: Mountain View, Calif.
17554	Components Inc.: Biddeford, Ma.
17675	Hamlin Metal Products Corp.: Akron, Ohio
17745	Angstrohm Prec. Inc.: No Hollywood, Calif.
17870	McGraw-Edison Co.: Manchester, N.H.
18042	Power Design Pacific Inc.: Palo Alto, Calif.
18083	Clevite Corp., Semiconductor Div.: Palo Alto, Calif.
18324	Signetics Corp.: Sunnyvale, Calif.
18476	Ty-Car Mfg. Co., Inc.: Holliston, Mass.
18486	TRW Elect. Comp. Div.: Des Plaines, Ill.
18583	Curtis Instrument, Inc.: Mt. Kisco, N.Y.
18612	Vishay Instruments Inc.: Malvern, Pa.
18873	E. I. DuPont and Co., Inc.: Wilmington, Del.
18911	Durant Mfg. Co.: Milwaukee, Wis.
19315	The Bendix Corp., Navigation & Control Div.: Teterboro N. J.
19500	Thomas A. Edison Industries, Div. of McGraw-Edison Co.: West Orange, N.J.
19589	Concoa: Baldwin Park, Calif.
19644	LRC Electronics: Horseheads, N.Y.
19701	Electra Mfg. Co.: Independence, Kansas
20183	General Atronics Corp.: Philadelphia, Pa.
21226	Executone, Inc.: Long Island City, N.Y.
21335	Fafnir Bearing Co., The: New Britain, Conn.
21520	Fansteel Metallurgical Corp.: N. Chicago, Ill.
23042	Texscan Corp.: Indianapolis, Ind.
23783	British Radio Electronics Ltd.: Washington, D.C
24455	G. E. Lamp Division: Nela Park, Cleveland, Ohio
24655	General Radio Co.: West Concord, Mass.

LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer/Address
24681	Memcor Inc., Comp. Div.: Huntington, Ind.
24796	Parelco Inc.: San Juan Capistrano, Calif.
26365	Gries Reproducer Corp.: New Rochelle, N.Y.
26462	Grobet File Co. of America, Inc.: Carlstadt, N.J
26851	Compac/Hollister Co.: Hollister, Calif.
26992	Hamilton Watch Co.: Lancaster, Pa.
27014	National Semi-Conductor: Santa Clara, Calif.
27251	Specialities Mfg. Co., Inc.: Stratford, Conn.
28480	Hewlett-Packard Co.: Palo Alto, Calif.
28520	Heyman Mfg. Co.: Kenilworth, N. J.
30817	Instrument Sepcialities Co., Inc.: Little Falls, N.J.
31433	Union Carbide: Greenville, S.C.
33173	G. E. Receiving Tube Dept.: Ownesboro, Ky.
35434	Lectrohm Inc.: Chicago, Ill
36196	Stanwyck Coil Products Ltd.: Hawkesbury, Ontario, Canada
36287	Cunningham, W. H. & Hill, Ltd.: Toronto Ontario, Canada
37942	P. R. Mallory & Co. Inc.: Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.: Akron, Ohio
40920	Miniature Precision Bearings, Inc.: Keene, N. H.
42190	Muter Co.: Chicago, Ill.
43990	C. A. Norgren Co.: Englewood, Colo.
44655	Ohmite Mfg. Co.: Skokie, Ill.
46384	Penn Eng. & Mfg. Corp.: Doylestown, Pa.
47904	Polaroid Corp.: Cambridge, Mass.
48620	Precision Thermometer & Inst. Co.: Southampton, Pa.
49956	Microwave & Power Tube Div.: Waltham, Mass.
50139	Allen Bradley: Salt Lake City, Utah
50434	Hewlett-Packard Co.: Palo Alto, Calif.
52090	Rowan Controller Co.: Westminster, Md.
53983	Sanborn Company: Waltham, Mass.
54294	Shallcross Mfg. Co.: Selma, N.C.
55026	Simpson Electric Co.: Chicago, Ill.
55933	Sonotone Corp.: Elmsford, N.Y.
55938	Raytheon Co. Commercial Apparatus & Systems Div.: So. Norwalk, Conn.
56137	Spaulding Fibre Co., Inc. Tonawanda, N.Y.
56289	Sprague Electric Co.: North Adams, Mass.
59446	Telex Corp.: Tulsa, Okla.
59730	Thomas & Betts Co.: Elizabeth, N.J.
60741	Triplett Electrical Inst. Co.: Bluffton, Ohio
61775	Union Switch and Signal, Div. of Westinghouse Air Brake Co.: Pittsburgh, Pa.
62119	Universal Electric Co.: Owosso, Mich.
63743	Ward-Leonard Electric Co.: Mt. Vernon, N.Y.
64959	Western Electric Co., Inc.: New York, N.Y.
65092	Weston Inst. Inc. Weston-Newark: Newark, N.J.
66295	Wittek Mfg. Co.: Chicago, Ill.
66346	Minnesota Mining & Mfg. Co. Revere Mincom Div.: St. Paul, Minn.
70109	Adams and Westlake: Elkhart, Ind.
70276	Allen Mfg. Co.: Hartford, Conn.
70309	Allied Control: New York, N.Y.
70318	Allmetal Screw Product Co., Inc.: Garden City, N.Y.
70417	Amplex, Div. of Chrysler Corp. Detroit, Mich.
70485	Atlantic India Rubber Works, Inc.: Chicago, Ill.
70563	Amperite Co., Inc.: Union City, N.J.
70674	ADC Products Inc.: Minneapolis, Minn.
70903	Belden Mfg. Co.: Chicago, Ill.
70998	Bird Electronic Corp.: Cleveland, Ohio
71002	Birnbach Radio Co.: New York, N.Y.
71034	Bliley Electric Co., Inc.: Erie, Pa.
71041	Boston Gear Works Div. of Murray Co. of Texas: Quincy, Mass.
71218	Bud Radio, Inc.: Willoughby, Ohio.
71279	Cambridge Thermionics Corp.: Cambridge, Mass.
71286	Camloc Fastener Corp.: Paramus, N.J.
71313	Cardwell Condenser Corp.: Lindenhurst, L.I., N.Y.
71400	Bussmann Mfg. Div. of McGraw-Edison Co.: St. Louis, Mo.
71436	Chicago Condenser Corp.: Chicago, Ill.
71447	Calif. Spring Co., Inc.: Pico-Rivera, Calif.
71450	CTS Corp.: Elkhart, Ind.
71468	ITT Cannon Electric Inc.: Los Angeles, Calif.
71471	Cinema, Div. Aerovox Corp.: Burbank, Calif:
71482	C. P. Glare & Co.: Chicago, Ill.
71590	Centralab Div. of Globe Union Inc. Milwaukee, Wis.
71616	Commercial Plastics Co.: Chicago, Ill.
71700	Cornish Wire Co., The: New York, N.Y.
71707	Coto Coil Co., Inc.: Providence, R.I.
71744	Chicago Miniature Lamp Works: Chicago, Ill.
71785	Cinch Mfg. Co., Howard B. Jones Div.: Chicago, Ill.
71984	Dow Corning Corp.: Midland, Mich.
72136	Electro Motive Mfg. Co., Inc.: Willimantic, Conn.
72619	Dialight Corp.: Brooklyn, N.Y.
72656	Indiana General Corp., Electronics Div.: Keasby, N.J.
72699	General Instrument Corp., Cap. Div. Newark, N.J.
72765	Drake Mfg. Co.: Harwood Heights, Ill.
72825	Hugh H. Eby Inc.: Philadelphia, Pa.
72928	Gudeman Co.: Chicago, Ill.
72962	Elastic Stop Nut Corp.: Union,N.J.
72964	Robert M. Hadley Co.: Los Angeles, Calif.
72982	Erie Technological Products, Inc.: Erie, Pa.
73061	Hansen Mfg. Co., Inc.: Princeton, Ind.
73076	H. M. Harper Co.: Chicago, Ill.
73138	Helipot Div. of Beckman Inst., Inc.: Fullerton, Calif.
73293	Hughes Products Division of Hughes Aricraft Co.: Newport Beach, Calif.
73445	Amperex Elect. Co.: Hicksville, L.I., N.Y.
73506	Bradley Semiconductor Corp.: New Haven, Conn.
73559	Carling Electric, Inc.: Hartford, Conn.
73586	Circle F. Mfg. Co.: Trenton, N.J.
73682	George K. Garrett Co., Div. MSL Industries Inc.: Philadelphia, Pa.
73734	Federal Screw Products Inc.: Chicago, Ill.
73743	Fischer Special Mfg. Co.: Cincinnati, Ohio
73793	General Industries Co., The: Elyria, Ohio
73846	Goshen Stamping & Tool Co.: Goshen, Ind.
73899	JFD Electronics Corp.: Brooklyn, N.Y.
73905	Jennings Radio Mfg. Corp.: San Jose, Calif.
73957	Groov-Pin Corp.: Ridgefield, N.J.
74276	Signalite Inc.: Nepture, N.J.
74455	J. H. Winns, and Sons: Winchester, Mass.
74861	Industrial Condenser Corp.: Chicago, Ill.
74868	R. F. Products Division of Amphenol-Borg Electronics Corp.: Danbury, Conn.

LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer/Address
74970	E. F. Johnson Co.: Waseca, Minn.
75042	International Resistance Co.: Philadelphia, Pa.
75263	Keystone Carbon Co., Inc.: St. Marys, Pa.
75378	CTS Knights Inc.: Sandwich, Ill.
75382	Kulka Electric Corporation: Mt. Vernon, N.Y.
75818	Lenz Electric Mfg. Co.: Chicago, Ill.
75915	Littlefuse, Inc.: Des Plaines, Ill.
76005	Lord Mfg. Co.: Erie, Pa.
76210	C. W. Marwedel: San Francisco, Calif.
76433	General Instrument Corp., Micamold Division: Newark, N.J.
76487	James Millen Mfg. Co., Inc.: Malden, Mass.
76493	J. W. Miller Co.: Los Angeles, Calif.
76530	Cinch-Monadnock, Div. of United Carr Fastener Corp.: San Leandro, Calif.
76545	Mueller Electric Co.: Cleveland, Ohio
76703	National Union: Newark, N.J.
76854	Oak Manufacturing Co.: Crystal Lake, Ill.
77068	The Bendix Corp., Electrodynamics Div.: N. Hollywood, Calif.
77075	Pacific Metals Co.: San Francisco, Calif.
77221	Phanostran Instrument and Electronic Co.: South Pasadena, Calif.
77252	Philadelphia Steel and Wire Corp.: Philadelphia, Pa.
77342	American Machine & Foundry Co. Potter & Brumfield Div.: Princeton, Ind.
77630	TRW Electronic Components Div.: Camden, N.J.
77638	General Instrument Corp., Rectifier Div.: Brooklyn, N.Y.
77764	Resistance Products Co.: Harrisburg, Pa.
77969	Rubbercraft Corp. of Calif.: Torrance, Calif.
78189	Shakeproof Division of Illinois Tool Works: Elgin, Ill.
78277	Sigma: S. Braintree, Mass.
78283	Signal Indicator Corp.: New York, N.Y.
78290	Struthers–Dunn Inc.: Pitman, N.J.
78424	Speciality Leather Prod. Co.: Newark, N.J.
78452	Thompson-Bremer & Co.: Chicago, Ill.
78471	Tilley Mfg. Co.: San Francisco, Calif.
78488	Stackpole Carbon Co.: St. Marys, Pa.
78493	Standard Thomson Corp.: Waltham, Mass.
78553	Tinnerman Products, Inc.: Cleveland, Ohio
78790	Transformer Engineers: San Gabriel, Calif.
78947	Ucinite Co.: Newtonville, Mass.
79136	Waldes Kohinoor Inc.: Long Island City, N.Y.
79142	Veeder Root, Inc.: Hartford, Conn.
79251	Wenco Mfg. Co.: Chicago, Ill.
79727	Continental-Wirt Electronics Corp.: Philadelphia, Pa.
79963	Zierick Mfg. Corp.: New Rochelle, N.Y.
80031	Mepco Division of Sessions Clock Co.: Morristown, N.J.
80120	Schnitzer Alloy Products Co.: Elizabeth, N.J.
80131	Electronic Industries Association. Any brand Tube meeting EIA Standards: Washington, D.C.
80207	Unimax Switch, Div. Maxon Electronics Corp.: Wallingford, Conn.
80223	United Transformer Corp.: New York, N.Y.
80248	Oxford Electric Corp.: Chicago, Ill.
80294	Bourns Inc.: Riverside, Calif.
80411	Acro Div. of Robertshaw Controls Co.: Columbus, Ohio
80486	All Star Products Inc.: Defiance, Ohio
80509	Avery Label Co.: Monrovia, California
80583	Hammerlund Co., Inc.: Mars Hill, N.C.
80640	Stevens, Arnold, Co., Inc.: Boston, Mass.
80813	Dimco Gray Co.: Dayton, Ohio
81030	International Instruments Inc.: Orange, Conn.
81073	Grayhill Co.: LaGrange, Ill.
81095	Triad Transformer Corp.: Venice, Calif.
81312	Winchester Elec, Div. Litton Ind., Inc.: Oakville, Conn.
81349	Military Specification
81483	International Rectifier Corp.: El Segundo, Calif.
81541	Airpax Electronics, Inc.: Cambridge, Maryland
81860	Barry Controls, Div. Barry Wright Corp.: Watertown, Mass.
82042	Carter Precision Electric Co.: Skokie, Ill.
82047	Sperti Faraday Inc., Copper Hewitt Electric Div.: Hoboken, N.J.
82116	Electric Regulator Corp.: Norwalk, Conn.
82142	Jeffers Electronics Division of Speer Carbon Co.: DuBois, Pa.
82170	Fairchild Camera & Inst. Corp. Space & Defense System Div.: Paramus, N.J.
82209	Maguire Industries, Inc.: Greenwich, Conn.
82219	Sylvania Electric Prod. Inc. Electronic Tube Division: Emporium, Pa.
82376	Astron Corp.: East Newark, Harrison, N.J.
82389	Switchcraft, Inc.: Chicago, Ill.
82647	Metals & Controls Inc. Spencer Products: Attleboro, Mass.
82768	Phillips-Advance Control Co.: Joliet, Ill.
82866	Research Products Corp.: Madison, Wis.
82877	Rotron Mfg. Co., Inc.: Woodstock, N.Y.
82893	Vector Electronic Co.: Glendale, Calif.
83014	Hartwell Corp.: Los Angeles, Calif.
83058	Carr Fastener Co.: Cambridge, Mass.
83086	New Hampshire Ball Bearing, Inc.: Peterborough, N.H.
83125	General Instrument Corp., Capacitor Div.: Darlington, S.C.
83148	ITT Wire and Cable Div.: Los Angeles, Calif.
83186	Victory Eng. Corp.: Springfield, N.J.
83298	Bendix Corp., Red Bank Div.: Red Bank, N.J.
83315	Hubbell Corp.: Mundelein, Ill.
83324	Rosan Inc.: Newport Beach, Calif.
83330	Smith, Herman H., Inc.: Brooklyn, N.Y.
83332	Tech Labs: Palisade's Park, N.J.
83385	Central Screw Co.: Chicago, Ill.
83501	Gavitt Wire and Cable Co. Div. of Amerace Corp.: Brookfield, Mass.
83594	Burroughs Corp. Electronic Tube Div.: Plainfield, N.J.
83740	Union Carbide Corp. Consumer Prod. Div.: New York, N.Y.
83777	Model Eng. and Mfg., Inc.: Huntington, Ind.
83821	Loyd Scruggs Co.: Festus, Mo.
83942	Aeronautical Inst. & Radio Co.: Lodi, N.J.
84171	Arco Electronics Inc.: Great Neck, N.Y.
84396	A. J. Glesener Co., Inc.: San Francisco, Calif.
84411	TRW Capacitor Div.: Ogallala, Neb.
84970	Sarkes Tarzian, Inc.: Bloomington, Ind.
85454	Boonton Molding Company: Boonton, N.J.

LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer/Address
85471	A. B. Boyd Co.: San Francisco, Calif.
85474	R. M. Bracamonte & Co.: San Francisco, Calif.
85660	Koiled Kords, Inc. : Hamden, Conn
85911	Seamless Rubber Co.: Chicago, Ill.
86174	Fafnir Bearing Co.: Los Angeles, Calif.
86197	Cilfton Precision Products Co., Inc.: Clifton Heights, Pa.
86579	Precision Rubber Products Corp.: Dayton, Ohio
86684	Radio Corp. of America, Electronic Comp. & Devices Div.: Harrison, N.J.
86928	Seastrom Mfg. Co.: Glendale, Calif.
87034	Marco Industries: Anaheim, Calif.
87216	Philco Corporation (Lansdale Division): Lansdale, Pa.
87473	Western Fibrous Glass Products Co.: San Francisco, Calif.
87664	Van Waters & Rogers Inc.: San Francisco, Calif.
87930	Tower Mfg. Corp.: Providence, R.I.
88140	Cutler-Hammer, Inc.: Lincoln, Ill.
88220	Gould-National Batteries, Inc.: St. Paul, Minn.
88698	General Mills, Inc.: Buffalo, N.Y.
89231	Graybar Electric Co.: Oakland, Calif.
89473	G. E. Distributing Corp.: Schenectady, N.Y.
89665	United Transformer Co.: Chicago, Ill.
90030	United Shoe Machinery Corp.: Beverly, Mass.
90179	U.S. Rubber Co., Consumer Ind. & Plastics Prod. Div.: Passaic, N.J.
90970	Bearing Engineering Co.: San Francisco, Calif.
91146	ITT Cannon Elect., Inc., Salen Div.: Salem, Mass.
91260	Connor Spring Mfg. Co.: San Francisco, Calif.
91345	Miller Dial & Nameplate Co.: El Monte, Calif.
91418	Radio Materials Co.: Chicago, Ill.
91506	Augat Inc.: Attleboro, Mass.
91637	Dale Electronics, Inc.: Columbua, Nebr.
91662	Elco Corp.: Willow Grove, Pa.
91737	Gremar Mfg. Co., Inc.: Wakefield, Mass.
91827	K. F. Development Co.: Redwood City, Calif.
91886	Malco Mfg. Co., Inc.: Chicago, Ill.
91929	Honeywell Inc., Micro Switch Div.: Freeport, Ill.
91961	Nahm-Bros. Spring Co.: Oakland, Calif.
92180	Tru-Connector Corp.: Peabody, Mass.
92367	Elgeet Optical Co. Inc.: Rochester, N.Y.
92607	Tensolite Insulated Wire Co., Inc.: Tarrytown, N.Y.
92702	IMC Magnetics Corp.: Wesbury Long Island, N.Y.
92966	Hudson Lamp Co.: Kearney, N.J.
93332	Sylvania Electric Prod. Inc. Semiconductor Div.: Woburn, Mass.
93369	Robbins & Myers Inc.: Palisades Park, N.J.
93410	Stemco Controls, Div. of Essex Wire Corp.: Mansfield, Ohio
93459	Weinschel Engr. Co., Inc.: Gaithersburg, Md.
93632	Waters Mfg. Co.: Culver City, Calif.
93929	G. V. Controls: Livingston, N.J.
94137	General Cable Corp.: Bayonne, N.J.
94142	Phelps Dodge: Yonkers, N.Y.
94144	Raytheon Co., Comp. Div., Ind. Comp. Operations: Quincy, Mass.
94148	Scientific Electronics Products, Inc.: Loveland, Colo.
94145	Wagner Elect. Corp., Tung-Sol Div.: Newark, N.J.
94197	Curtiss-Wright Corp. Electronics Div.: East Paterson, N.J.
94222	South Chester Corp.: Chester, Pa.
94330	Wire Cloth Products, Inc.: Bellwood, Ill.
94375	Automatic Metal Products Co.: Brooklyn, N.Y.
94682	Worcester Pressed Aluminum Corp.: Worcester, Mass.
94696	Magnecraft Electric Co.: Chicago, Ill.
95023	George A. Philbrick Researchers, Inc.: Boston, Mass.
95236	Allies Products Corp.: Dania, Fla.
95238	Continental Connector Corp.: Woodside, N.Y.
95263	Leecraft Mfg. Co., Inc.: Long Island, N.Y.
95265	National Coil Co.: Sheridan, Wyo.
95275	Vitramon, Inc.: Bridgeport, Conn.
95348	Gordos Corp.: Bloomfield, N.J.
95354	Methode Mfg. Co.: Rolling Meadows, Ill.
95566	Arnold Engineering Co.: Marengo, Ill.
95712	Dage Electric Co., Inc.: Franklin Ind.
95984	Siemon Mfg. Co.: Wayne, Ill.
95987	Weckesser Co.: Chicago, Ill.
96067	Microwave Assoc., West Inc.: Sunnyvale, Calif.
96095	Hi-Q Div. of Aerovox Corp.: Olean, N.Y.
96156	Thordarson-Meissner Inc.: Mt. Carmel, Ill.
96296	Solar Manufacturing Co.: Los Angeles, Calif.
96306	Microswitch, Div. of Minn.—Honeywell: Freeport, Ill.
96330	Carlton Screw Co.: Chicago, Ill.
96341	Microwave Associates, Inc.: Burlington, Mass.
96501	Excel Transformer Co.: Oakland, Calif.
96733	San Fernando Elect. Mfg. Co.: San Fernando, Calif.
96881	Thomson Ind. Inc.: Long Is., N.Y.
97464	Industrial Retaining Ring Co.: Irvington, N.J.
97539	Automatic & Precision Mfg.: Englewood, N.J.
97979	Reon Resistor Corp.: Yonkers, N.Y.
97983	Litton System Inc., Adler-Westrex Commun. Div.: New Rochelle, N.Y.
98144	R-Tronics, Inc.: Jamaica, N.Y.
98159	Rubber Teck, Inc.: Gardena, Calif.
98220	Hewlett-Packard Co., Moseley Div.: Pasadena, Calif.
98278	Microdot, Inc.: So. Pasadena, Calif.
98291	Sealectro Corp.: Mamaroneck, N.Y.
98376	Zero Mfg. Co.: Burbank, Calif.
98410	Etc. Inc.: Cleveland, Ohio
98731	General Mills Inc., Electronics Div. Minneapolis, Minn.
98734	Paeco Div. of Hewlett-Packard Co.: Palo Alto, Calif.
98821	North Hills Electronics, Inc.: Glen Cove, N.Y.
98978	International Electronic Research Corp.: Burbank, Calif.
99109	Columbia Technical Corp.: New York, N.Y.
99313	Varian Associates: Palo Alto, Calif.
99378	Atlee Corp.: Winchester, Mass.
99515	Marshall Ind., Capacitor Div.: Monrovia, Calif.
99707	Control Switch Division, Controls Co. of America: El Segundo, Calif.
99800	Delevan Electronics Corp.: East Aurora, N.Y.
99848	Wilco Corporation: Indianapolis, Ind.
99928	Branson Corp.: Whippany, N.J.
99934	Renbrandt, Inc.: Boston, Mass.
99942	Hoffman Electronics Corp. Semiconductor Div.: El Monte, Calif.
99957	Technology Instrument Corp. of Calif.: Newbury Park, Calif.

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